TECHNOLOGY DEPT.

August, 1950

THE FOUNDRY

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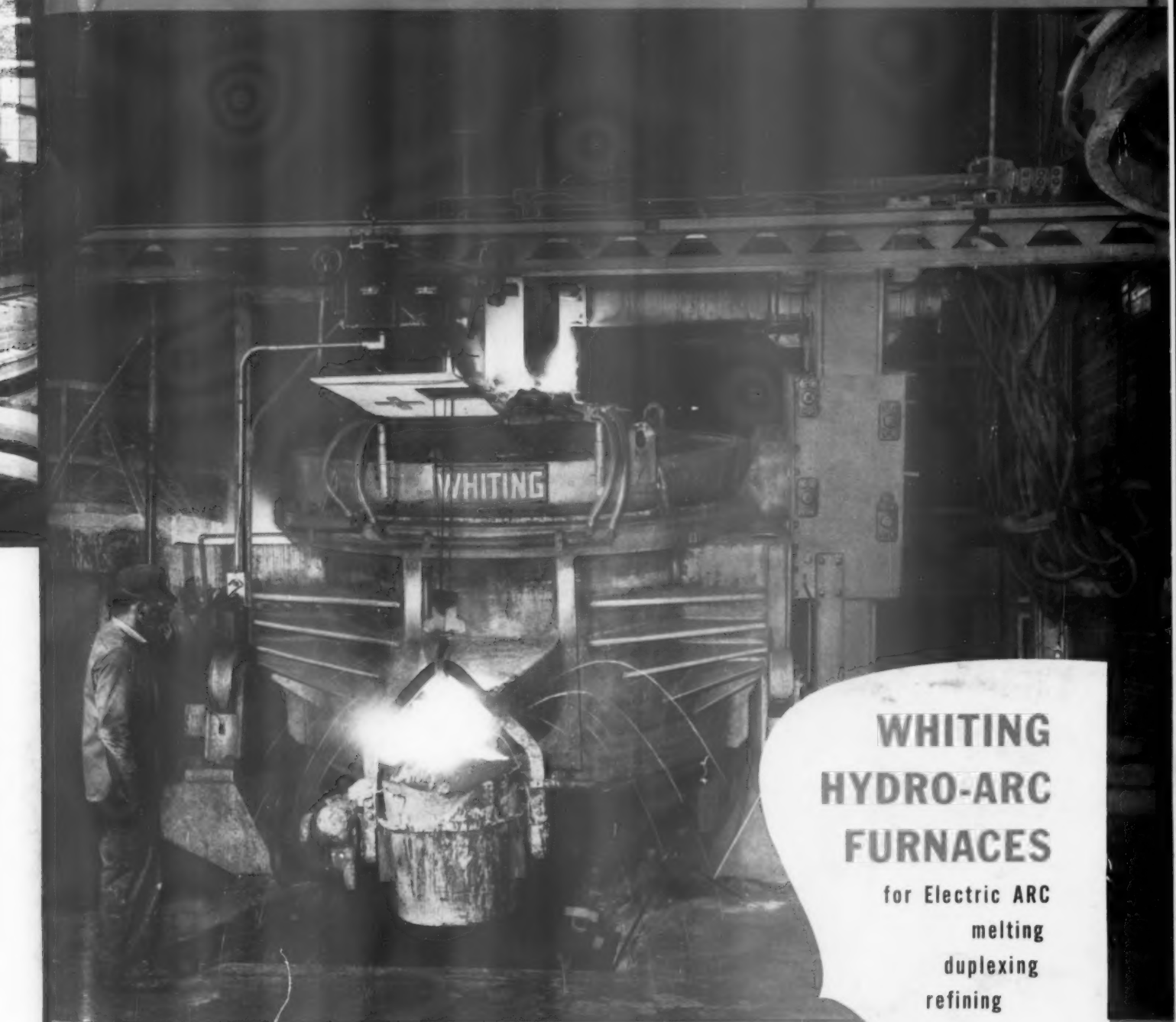
DETROIT

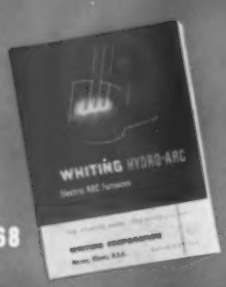
wherever metals are cast...



WHITING HYDRO-ARC FURNACES

for Electric ARC
melting
duplexing
refining

✔ BETTER METALLURGICAL CONTROL
✔ MORE TONS PER HOUR
✔ LOWER COST PER TON



Ask for
NEW BULLETIN FY-168

WHITING CORPORATION 15607 LATHROP AVE., HARVEY, ILL.

how PURITE assures Cleaner Iron Better Castings through

CONVENIENT, ECONOMICAL, EFFECTIVE FLUXING and DESULPHURIZING

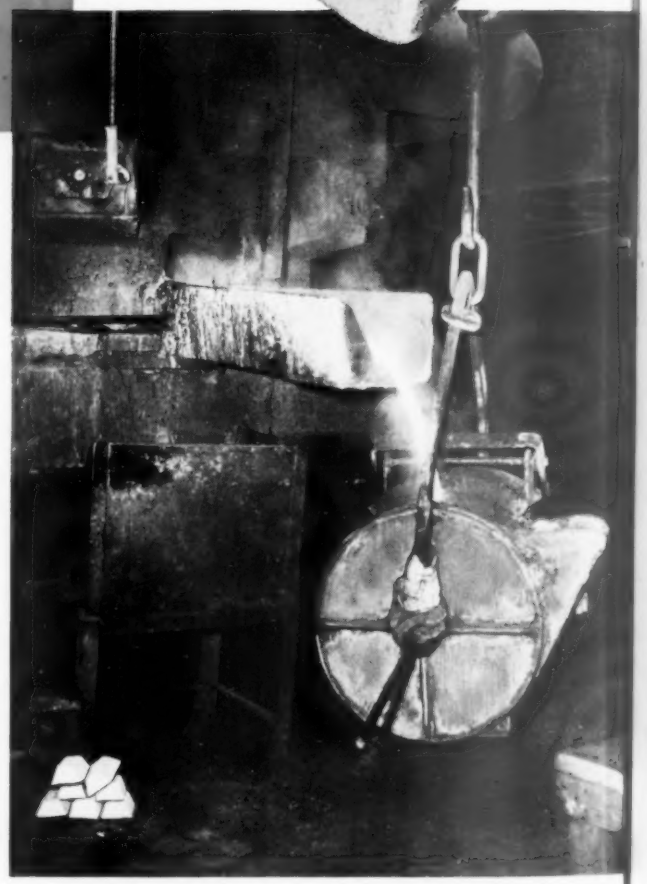
PURITE 100% FUSED SODA ASH

The Scientific Flux for Better Melting and Cleaner Iron

Purite is a country-wide foundry favorite. This broad acceptance is based on proven performance in producing better castings. Here are the reasons why Purite is first choice in foundry after leading foundry:

1. **Purite gives 100% fluxing action in the cupola—100% desulphurizing action in the ladle.**
2. **Purite gets to the iron faster—no quicker desulphurizer made.**
3. **Purite is time-tested and proven for unsurpassed desulphurizing uniformity.**
4. **Purite comes in 2 lb. pigs—no weighing or measuring required.**
5. **Purite is 100% pure fused soda ash—you do not pay for inert materials.**
6. **Purite does not crumble—no waste—no dust.**
7. **Purite can be shipped in bulk carloads at substantial savings over bag shipments—is easily stored without deterioration.**

For nearly 30 years there's been no substitute for this successful product. Confirm Purite's many advantages by an actual trial in your own cupolas and ladles. If you need further information, please write today to: Mathieson Chemical Corporation, Mathieson Building, Baltimore 3, Maryland.



Tapping a modern cupola at the foundry of Mack Trucks, Inc., at New Brunswick, N. J.

Mathieson CHEMICALS

Purite is sold by all leading foundry supply houses in the United States and Canada.

SERVING INDUSTRY, AGRICULTURE AND PUBLIC HEAL

NISILOY*

... A POWERFUL, POSITIVE INOCULANT

CUTS FINAL COST OF GRAY IRON CASTINGS

BENEFITS TO CASTING USERS

EXCELLENT MACHINING QUALITIES — The dense, gray, machinable structure secured with Nisiloy reduces machining time, tool wear, rejects and costs.

INCREASED WEAR-RESISTANCE — The formation and distribution of finely divided random flake graphite accomplished with Nisiloy assures highly improved resistance to wear.

IMPROVED TOUGHNESS—Nisiloy acts to eliminate hard, chilled areas in thin and thick sections alike . . . thus, the casting is thoroughly machinable yet less sensitive to breakage in machining operations and general service.

DEPENDABLE PRESSURE-TIGHTNESS — The sound, homogeneous structure attained by inoculating with Nisiloy results in dense cast iron that provides substantially improved pressure-tightness.

BENEFITS TO FOUNDRYMEN

REDUCES REJECTS—Used for structure control of cast iron, Nisiloy helps your foundry meet daily schedules for uniform lots of machinable gray iron castings.

PROMOTES SOUND CASTINGS — Diffusing rapidly throughout the melt, Nisiloy promotes a dense, close-grained product.

CURBS BREAKAGE — Even where section thickness varies sharply, Nisiloy serves to eliminate chilled edges and surfaces, thus affording a tougher cast iron that resists breakage in shop handling.

NO SCRAP PROBLEM—Containing only elements that dissolve freely in iron, Nisiloy permits remelting sprues and gates in any successive melt without risk of adding chill-forming elements.

FEWER BASE MIXTURES—Often a single base mixture may be used in the cupola to which Nisiloy is added in the ladle, with the consequent flexibility of pouring off thin or thick sectioned castings as desired.

Use the coupon below for full information about one of the most useful products ever offered for improving machinability and structure of gray iron castings. Nisiloy contains 60 per cent nickel, 30 per cent silicon, balance essentially iron. Fill in and mail the coupon now.

EMBLEM OF INCO SERVICE
TRADE MARK

THE INTERNATIONAL NICKEL COMPANY, INC.
Dept. TF, 67 Wall Street, New York 5, N. Y.

Please send me your booklet entitled,
"NISILOY" for GRAY IRON CASTINGS

Name.....*Title*.....

Company.....

Address.....

City.....*State*.....

*Trade Mark of The International Nickel Company, Inc.

THE INTERNATIONAL NICKEL COMPANY, INC.

67 WALL STREET
NEW YORK 5, N. Y.

A *Helping Hand*

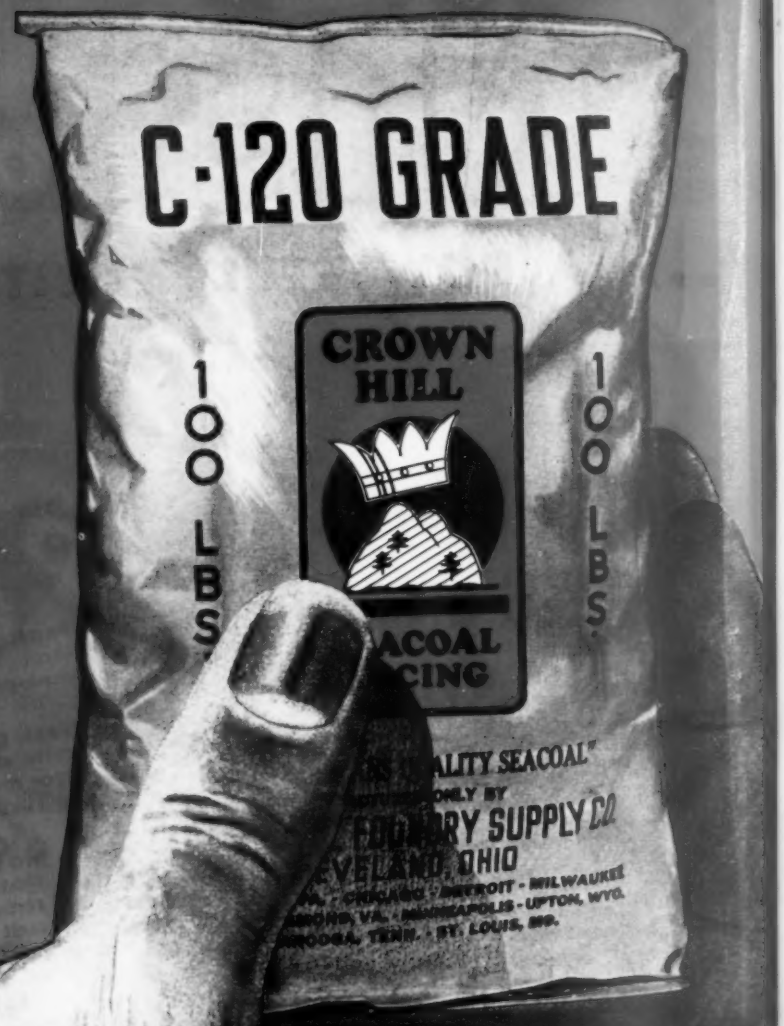
for Foundrymen Everywhere

● Foundrymen everywhere choose Crown Hill Seacoal Facing. Here's why: Crown Hill cuts cleaning costs, produces a smoother finish and eliminates hard spots.

Made from high volatile, quick-flash coal, Crown Hill vents rapidly. Low sulphur content eliminates hard spots. Because of the high fusion point of its small ash content, molten iron cannot fuse to it.

Put Crown Hill Seacoal Facing to the test in your own foundry (like so many others have) and see the difference.

Made by the Long-Time Friend of the Foundries



FIGURES FROM BUREAU OF MINES
DEPT. OF INTERIOR OF THE U. S.
(Moisture Free)

PROXIMATE ANALYSIS	
Volatile Matter (V.C.M.)	38.9%
Fixed Carbon	57.4%
Ash	3.7%
	100.0%

ULTIMATE ANALYSIS	
Hydrogen	5.4%
Carbon	82.0%
Nitrogen	1.6%
Oxygen	6.6%
Sulphur	.7%
Ash	3.7%
	100.0%
Fusion Point of Ash	2,980° F.

- *It vents the mold quickly*
- *Eliminates hard spots*
- *Cuts cleaning costs*

THE FEDERAL FOUNDRY SUPPLY COMPANY

Seacoal Plant
CROWN HILL, W. VA. • CHICAGO • DETROIT • MILWAUKEE • RICHMOND, VA.
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AUGUST, 1950

THE FOUNDRY

VOLUME 78—NUMBER 8

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Editorial 69

Diesel Engine Crankshafts Cast in Gray Iron 70
By ALEXANDER FINLAYSON

Use of Chills in Producing Tin Bronze Castings (Part IV) 76
By CLYDE L. FREAR

Producing Textile Machinery Castings 78
By PAT DWYER

Brake Drum Materials (Part II) 82
By FRED J. WALLS

Steel Foundry Core and Molding Sands (Part V) 85
By JOHN HOWE HALL

Nickel-Alloyed Brass and Bronze Castings 86
By JAMES S. VANICK

Salt Bath Cleaning of Gray Iron Castings 90
By ROBERT H. HERRMANN

Plastic Bonded Shell Molds Used in New Casting Process 92
By BERNARD N. AMES, SEYMOUR B. DONNER and NOAH A. KAHN

Origin and Control of Carbon in Ferrous Alloys 97
By HARRY A. SCHWARTZ

Malleable Founders' Society Holds Annual Meeting 110
By WILLIAM G. GUDE

ASTM Annual Meeting 112
By FRANK G. STEINEBACH

British Foundry Conference 133
By VINCENT DELPORT

Man-to-Man on the Molder's Bench 140
By RALPH L. LEE

Mechanizes Production of Textile Machinery Castings 146

The Croning Process 170

The Adventures of Bill 172
By PAT DWYER

Questions and Answers 98
Industry Briefs 102
Men of Industry 104
Around the Country 122
Obituary 124
Foundry Developments 126
Foundry Data Sheet 129
Meeting Calendar 142
Foundry Statistics 144
Activities of Foundry Groups 156
New Equipment and Supplies 194
Helpful Literature 197
With the Editors 218
Trade Publications 220
Where-to-Buy Directory 240
Advertisers' Index 260

Good Speed

W. A. JONES

Setting herringbone gears into the well of a large speed reducer housing. LINOIL "well" cores give a smooth, oil-tight casting surface.

Gear blanks that have been cast in dry sand molds. Casting them this way means more accurate dimensions, better finish.

A completed Jones Herringbone Speed Reducer. Units are available with ratios that range from 1.27 to 1 up as high as 355.8 to 1.

Reducer Cores Depend On LINOIL

FOUNDRY & MACHINE CO.
CHICAGO . . . . . ILLINOIS

Like to hear why R. Grant Eddinger, Foundry Superintendent at the W. A. Jones Foundry and Machine Company, uses LINOIL to make the cores for his speed reducer castings?

..."Much of our core work runs on the chunky side," says Mr. Eddinger, "Some 'well' cores weigh as much as 3000 pounds. We don't like to use coke centers in this big stuff because the cores have to be good and strong to support their own weight. But making a solid sand core with LINOIL is easy — the cores bake right through the center and don't have soggy spots to cause trouble. LINOIL cores bake rapidly, too."

Another important point about these cores is that they must produce a smooth casting surface, free of sand inclusions, since the housings are designed to be oil tight.

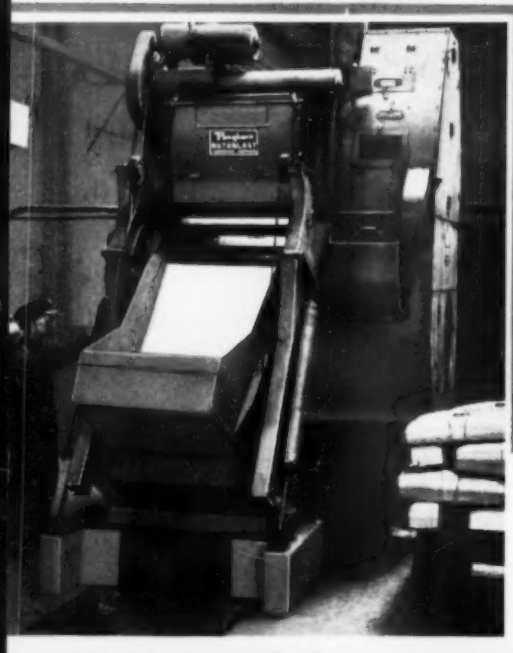
Large gear blanks are cast in dry sand molds for better surface finish.

LINOIL makes better, more dependable cores for any type of casting. Remember, whether you pour iron, steel, or aluminum, there is a grade of LINOIL to fit your needs.

LINOIL
THE LOGICAL OIL

ARCHER-DANIELS-MIDLAND COMPANY
(THE WERNER G. SMITH COMPANY DIV.)
2191 WEST 110th STREET · CLEVELAND 2, OHIO

Want to Save



SHOWN INSPECTING RADIATOR PARTS BEFORE AND AFTER CLEANING, C. N. Deubner and Floyd Wells of Yates-American Machine Co. agree: "ROTOBLAST saves money!" Five old-style machines have been replaced by the one ROTOBLAST Barrel shown in the smaller photo. Cash savings each year total more than $5000—proof ROTOBLAST is economical!

FOUNDRY EQUIPMENT MANUFACTURERS ASSOCIATION INC. MEMBER FEMA

Pangborn

* Trademark of Pangborn Corporation

$5000 per Year?

Read how manufacturers save money with Pangborn ROTOBLAST*!

Authentic cases in our files *prove* Pangborn ROTOBLAST *saves money* on blast cleaning. For example, take this performance at Yates-American Machine Co., manufacturers of high-quality heat transfer products. Since ROTOBLAST went into operation they have saved more than $5000 a year on blast cleaning!

Other Pangborn users report equally impressive annual savings of five, ten, eleven thousand dollars *and more* when ROTOBLAST takes over a blast cleaning job. Throughout industry, for companies like General Electric, General Motors, Ford... ROTOBLAST saves time and labor, and keeps cleaning costs low *without sacrificing quality!*

WHAT ABOUT YOUR PLANT?

If you clean castings, forgings or heat-treated parts, and if you want to save time, money and manpower ... find out about ROTOBLAST. There's a standard Pangborn Table, Barrel, Room or Table-Room designed for every cleaning job. To get specifications, descriptions and full facts, write for Bulletin 214. Just address: PANGBORN CORPORATION, 1400 Pangborn Blvd., Hagerstown, Maryland.

ROTOBLAST

$ SAVES LABOR: *One ROTOBLAST machine and operator can do as much as a two-man crew and old-fashioned equipment.*

$ SAVES SPACE: *In many cases, one ROTOBLAST machine replaces five or more old-fashioned machines, requires less space.*

$ SAVES TIME: *Cases on record prove ROTOBLAST can cut cleaning time up to 95.8% compared with old-style methods.*

$ SAVES POWER: *Modern ROTOBLAST uses but 15-20 h.p. compared to old-fashioned equipment requiring 120 h.p. for same job.*

$ SAVES TOOLS: *On work cleaned with ROTOBLAST, cutting tools last up to ⅔ longer because no scale is left to dull edges.*

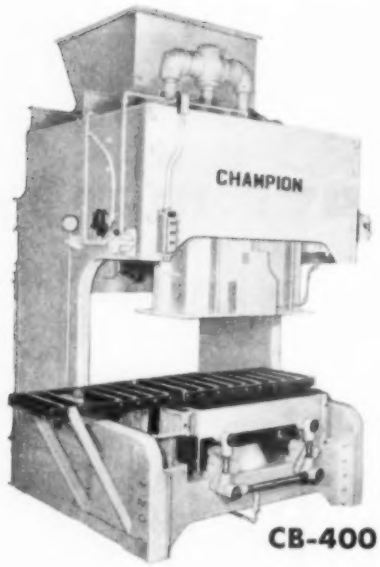
... and these savings mean INCREASED PROFITS for you!

Look to Pangborn for the Latest Developments in Blast Cleaning and Dust Control Equipment

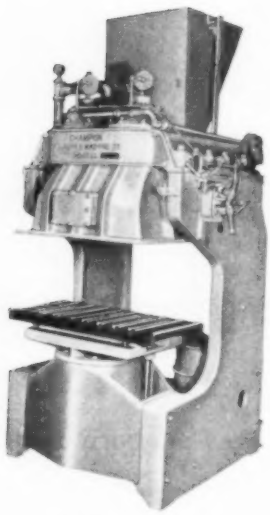
MORE THAN 25,000 PANGBORN MACHINES SERVING INDUSTRY

BLAST CLEANS CHEAPER

with the right equipment for every job



CB-400



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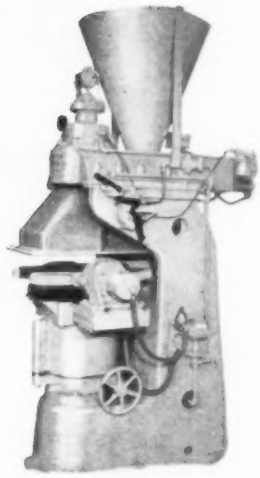
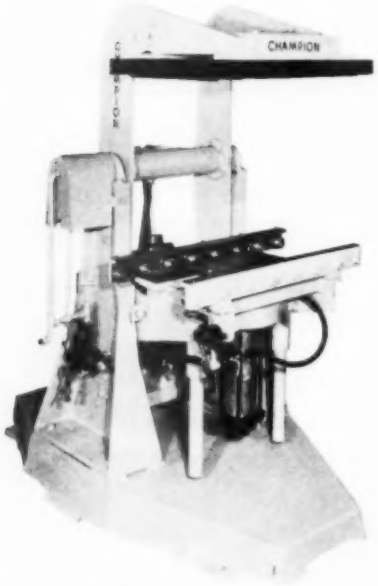


CB-15

Champion Core B

The broad Champion line includes a core making or molding machine for practically any requirement of your production foundry. Rugged, simple and speedy, these machines are truly outstanding standards of efficiency and high production in the industry today. Available with automatic controls.



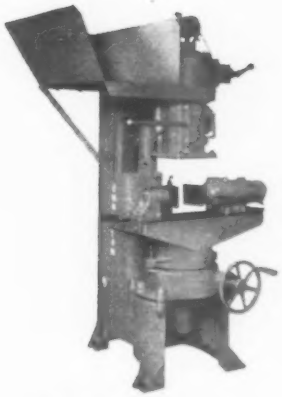
Champion CR Rollover

The newest addition to the Champion family, the Champion CR rollover and draw machine in combination with Champion Core Blowers make a winning high production team.

What are your Core or Molding Requirements?

A Champion production specialist can show you how Champion machines can fit into your foundry scheme to better your production quantity and quality at lower cost. Ask him to call on you today.

CB-12



CB-10

CB-5

Blowers hike production!

Foundrymen find extreme simplicity of design and operation pays dividends

When simplicity and compactness of design team up with speed and accuracy in a precision-built core blowing machine, then, Brother, you've really got a winning combination—real Champions all along the line. Profit-minded foundrymen realize that Champion simplicity and compactness pays off in time, space, money. In comparing core blowers you, too, will find that Champion Core Blowers have:

MINIMUM operations
MINIMUM levers
MINIMUM hoses and pipes
MINIMUM effort in operating
MINIMUM air consumption
MINIMUM maintenance

all adding up to MAXIMUM efficiency and production in your foundry.

CHAMPION FOUNDRY AND MACHINE COMPANY

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GENERAL OFFICE AND PLANT • ROCKFORD, ILLINOIS
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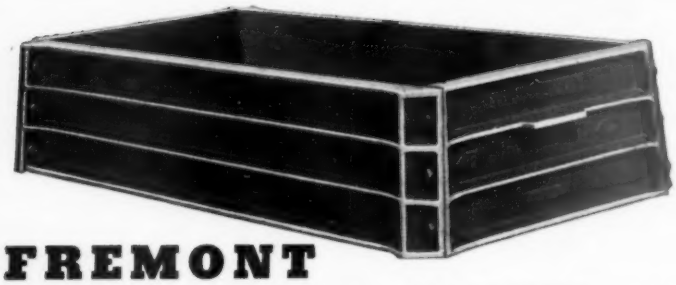
Avenida R.S. Penna 852, Buenos Aires R-26, Argentina

BRAZIL
W. F. Guth Foundry Engineering, Caixa Postal 1411, Sao Paulo

CHILE
Mauricio Hochschild & Cia. Ltd., Casilla 153 D, Santiago, Chile

Wells Mfg. Co.'s new foundry in Skokie, Ill. Its 28,800 sq. ft. of floor is well covered by Fremont cast iron jackets and magnesium flasks. They're standard equipment.



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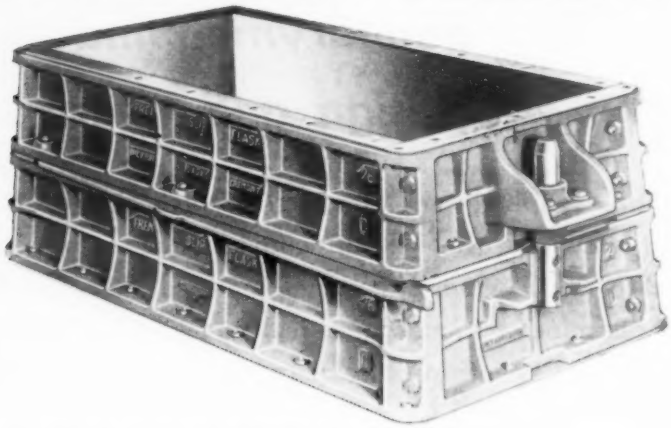
CAST IRON JACKETS



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MAGNESIUM FLASKS

BUILT FOR LONG SERVICE & FAST PRODUCTION

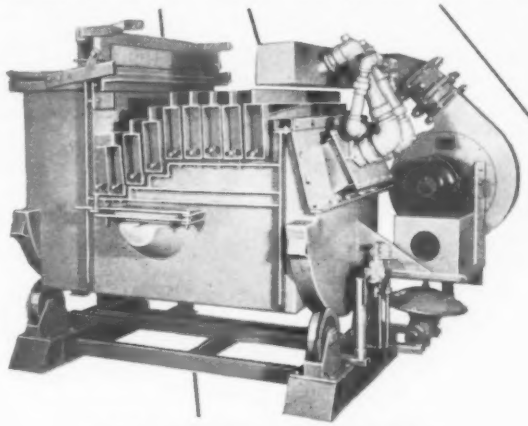
ALL ORDERS GIVEN VERY PROMPT ATTENTION

GROOVLOCK
THE FOOL-PROOF PIN

THE FREMONT FLASK CO.
Fremont, Ohio

4 WAYS TO *Greater Profits*
...FASTER MELTING
...BETTER SHOP CONDITIONS!

These four leading Stroman Furnaces are merely a part of the tremendous complete line of furnaces that Stroman makes for use in Foundries, Die Casting, Permanent Mold and Sand Casting Plants. Remember . . . Stroman builds any type or size furnace for any or all size melting problems. Each type furnace does its job exceptionally well, assuring lowest fuel costs, easiest operation, fastest melting and longest life. They are the furnaces you should consider above all others, for they are the acknowledged leaders in the field. Send your melting room problems to Stroman today . . . their engineers, who are qualified experts in melting room procedure and layout, will be only too glad to consult with you and offer suggestions for improvements and savings.



ECONOMELT FURNACES

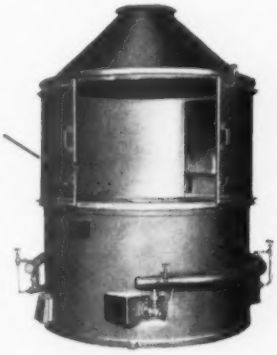
The finest direct fired reverberatory melting furnace ever offered. Melting speed for Brass, Bronze, Grey Iron or Aluminum is unmatched. Continuous charging. Cold metal does not reach the molten bath causing it to chill. All metal is preheated and melts in suspension. This furnace shows upward of 40% savings in fuel costs. Oil, gas or combination oil-gas fire. Capacities (Brass or Iron) up to 6000 lbs. Write for Bulletin 635 giving full information.

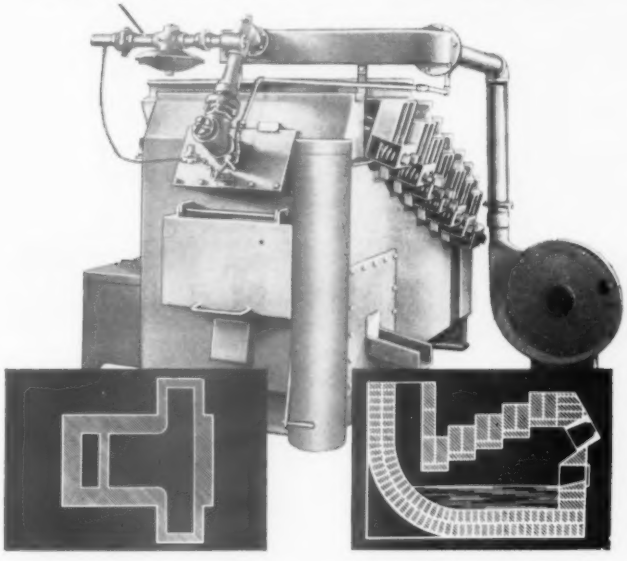
STROMAN RM STATIONARY CRUCIBLE MELTING AND HOLDING FURNACES FOR ALUMINUM

Built especially for use in permanent mold and die casting plants where molten metal is dipped from furnace with a hand ladle. Melting is done in crucible (no iron pick-up). Thoroughly insulated to protect the operator from heat. Oil, gas or combination oil-gas fire. Capacities, 200 to 800 lbs. Available with full automatic controls.

STROMAN IRON POT MELTING FURNACES FOR ZINC OR ALUMINUM

These furnaces are highly recommended as breakdown furnaces for zinc and aluminum die casting and permanent mold plants. They also excel as holding furnaces. They can be supplied either with or without hoods to exhaust fumes and heat. Their construction assures longest pot life and lowest fuel costs. Choice of automatic or manual controls and oil or gas fire. Capacities from 212 to 14,000 lbs. zinc.





Horizontal view showing 2 dip-out boxes.

Vertical view showing combustion chamber, metal bath, charging hopper and clean out door.

STROMAN MODEL MC ALUMINUM REVERBERATORY DIP-OUT FURNACE

It's New! Continuous charging and pouring make it without equal in low fuel and maintenance costs plus quality castings. Two Stromans in one . . . the combination of breakdown and holding furnaces makes this the most economical furnace ever designed for aluminum melting. It can be used for melting, holding, alloying fluxing for either casting or producing ingots. Cold metal does not reach the molten bath. Hot metal is always available for dipping. No iron pots or crucibles to buy. Bath capacities range from 500 to 10,000 lbs. Oil, gas or combination oil-gas fire.

Write for Complete Information at Once

STROMAN FURNACE & ENGINEERING CO.

DIVISION OF

THE PETERSEN OVEN CO. • 9900 FRANKLIN AVE. • FRANKLIN PARK, ILL.

Cut CLEANING ROOM COSTS WITH FINER FINISH CASTINGS

DELTA S-5 BLACKOAT CORE AND MOLD WASH

Delta Blackoat S-5 Core and Mold Wash, for grey iron castings, is a product of scientific research, conducted by Delta Foundry Research Laboratory in cooperation with one of the leading grey iron foundries in the mid-west. It's development solves critical difficulties, inherent in grey iron casting, which have persistently plagued foundrymen and foundry technicians.

Delta Blackoat S-5 is a distinctly new and different wash. It provides all of the well-known advantages of other Delta Core and Mold Washes plus the added advantages listed below.

Write for complete information. If you wish it we will send a liberal working sample to you for test purposes in your foundry.

5 IMPORTANT FACTS TO CONSIDER . . .

1. It's new and different. It has qualities and characteristics contained in no other wash. It substantially reduces cleaning room costs and greatly improves casting finish.

2. It produces results, on grey iron castings, unequalled by any other wash. It will not deform cores. Edges and corners remain clean and sharp.

3. It costs less to buy and is considerably more economical because you use it at a lower Baume.

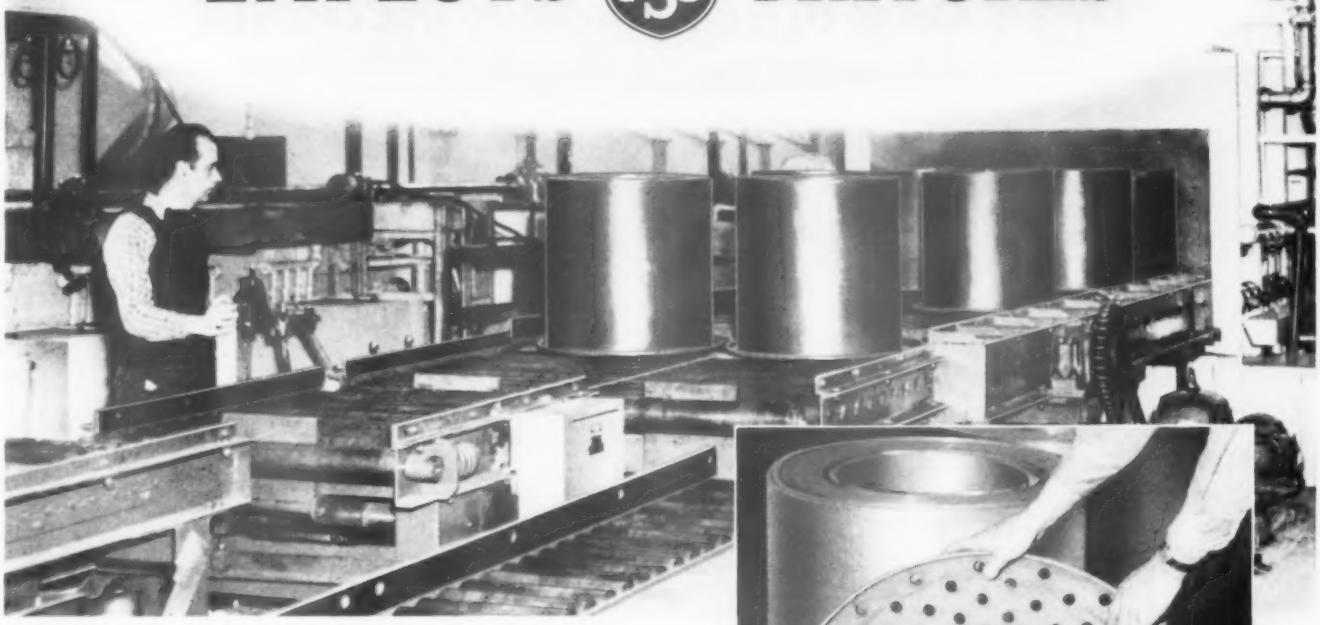
4. It can't flake or peel because it anchors itself by penetrating onto the sub-surface sand grains of cores and molds. It greatly increases the surface hot strength of the sand which prevents veining and metal penetration.

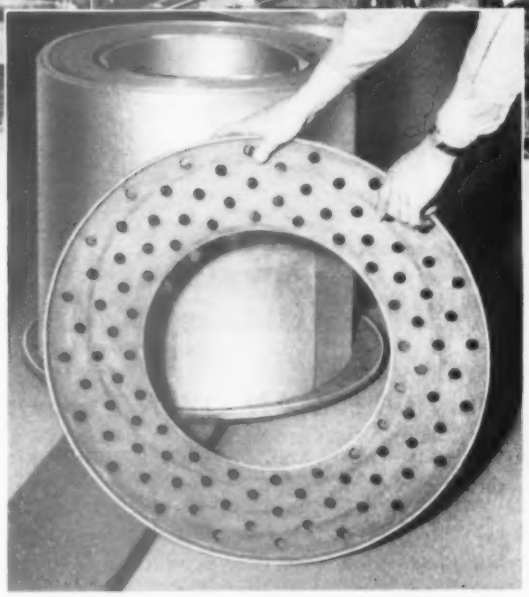
5. It is easily applied and adheres to any sand surface . . . green or dry . . . and produces a smooth, highly refractory, waterproof surface over which molten metal flows faster and without interruption.

DELTA OIL PRODUCTS CO.

MILWAUKEE 9, WISCONSIN

World's Largest
BRASS ANNEALING FURNACE
EMPLOYS PSC FIXTURES





Scovill's New Continuous Strip Mill Called "The Most Modernly Equipped"

With various production facilities that rank as the world's largest, the new brass strip mill of Scovill Manufacturing Co. at Waterbury, Conn., is also recognized as "the most modernly equipped".

Pressed Steel Co. light-weight heat-treating trays were chosen to convey the 2,000 lb. coils through the two brass annealing furnaces, also the world's largest. Pictured here, these PSC trays are seamless-formed of Inconel, are $\frac{1}{4}$" thick, $28\frac{3}{4}$" in diameter, and weigh 32 lbs. each. Under direct fire, 32,500 lbs. of coiled sheet are annealed per hour.

Pressed Steel Co. offers you the benefit of 20 years experience in designing heat-treating equipment. Alloy seamless formed or welded, in any size or design: annealing and carburizing boxes, covers, baskets, racks, tubes, retorts, etc. We fabricate the complete list of alloys, permitting you to choose the metal that is "alloy right" for your needs. Send blue prints or write as to your needs.

PSC EQUIPMENT IS "ALLOY RIGHT"

THE PRESSED STEEL COMPANY
of WILKES-BARRE, PENNSYLVANIA

Industrial Equipment of Heat and Corrosion Resistant WEIGHT-SAVING *Sheet Alloys*

☆ ☆ ☆ OFFICES IN PRINCIPAL CITIES ☆ ☆ ☆

COLEMAN OVENS

BAKE CORES AT LOWER COST

than any other known method!

COLEMAN CAR-TYPE OVENS AT COOPER-BESSEMER CORP.

Only COLEMAN OVENS provide ALL these money saving advantages:

- PERFECT BAKING AND DRYING—eliminating rejects and make-overs.
- LOWEST LABOR COST by utilizing the most efficient handling methods for *your* production requirements and plant conditions.
- MAXIMUM FUEL SAVINGS using the fuel most economically available to you.
- MOST ADVANTAGEOUS USE OF AVAILABLE FLOOR SPACE through efficient mechanical design.
- FLEXIBILITY AND ACCURATE CONTROL to bake oil or resin binders—whichever is most satisfactory for *your* casting requirements.
- DEPENDABLE PERFORMANCE AT LOWEST COST FOR UPKEEP through rugged, heavy duty construction, designed for foundry operating conditions.

COLEMAN OVENS are built in a complete range of sizes and capacities for every core-baking and mold drying requirement: Tower Ovens, Horizontal Conveyor Ovens, Car-Type Ovens, Transrack Ovens, Rolling Drawer Ovens, Portable Core Ovens, Portable Mold Dryers, etc.

For savings not possible with any other method, install COLEMAN OVENS. Write TODAY for Bulletin 48.

WORLD'S OLDEST AND LARGEST FOUNDRY OVEN SPECIALISTS

THE FOUNDRY EQUIPMENT COMPANY

1831 COLUMBUS ROAD — CLEVELAND 13, OHIO

Always Packed

...and ready to go Anywhere!

THE REPUBLIC PIG IRON METALLURGIST draws his pay check from us—*but, he works for you!* There is no charge for his services, and a phone call or letter will bring him to your plant in a hurry. Day or night he is ready to give you the benefit of his years of practical experience and the use of his thorough knowledge of all types of pig iron and their characteristics.

Whatever your problems may be . . . questions on molding practice . . . need for improving castings . . . or cutting production costs, it's a sure bet that your Republic Pig Iron Metallurgist can help you solve them. Just let us know when you would like him to call.

REPUBLIC STEEL CORPORATION
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York 17, N. Y.

Republic PIG IRON

"CHATEAUGAY" Low-Phosphorus, Copper-Free

"REPUBLIC" (Northern) Foundry, Basic and Malleable

"PIONEER" (Southern) Foundry and Basic

REPUBLIC STEEL

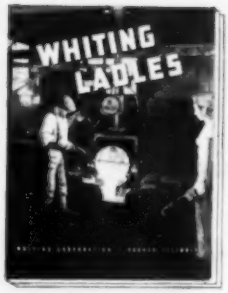
ALSO TRUSCON FOUNDRY FLASKS • REPUBLIC CORE WIRE • FOUNDRY NAILS

Let WHITING LADLES

It is easier to handle and pour hot metal with Whiting* Ladles because they are designed by practical foundrymen who know from personal experience exactly what is needed to assure smooth foundry operation.

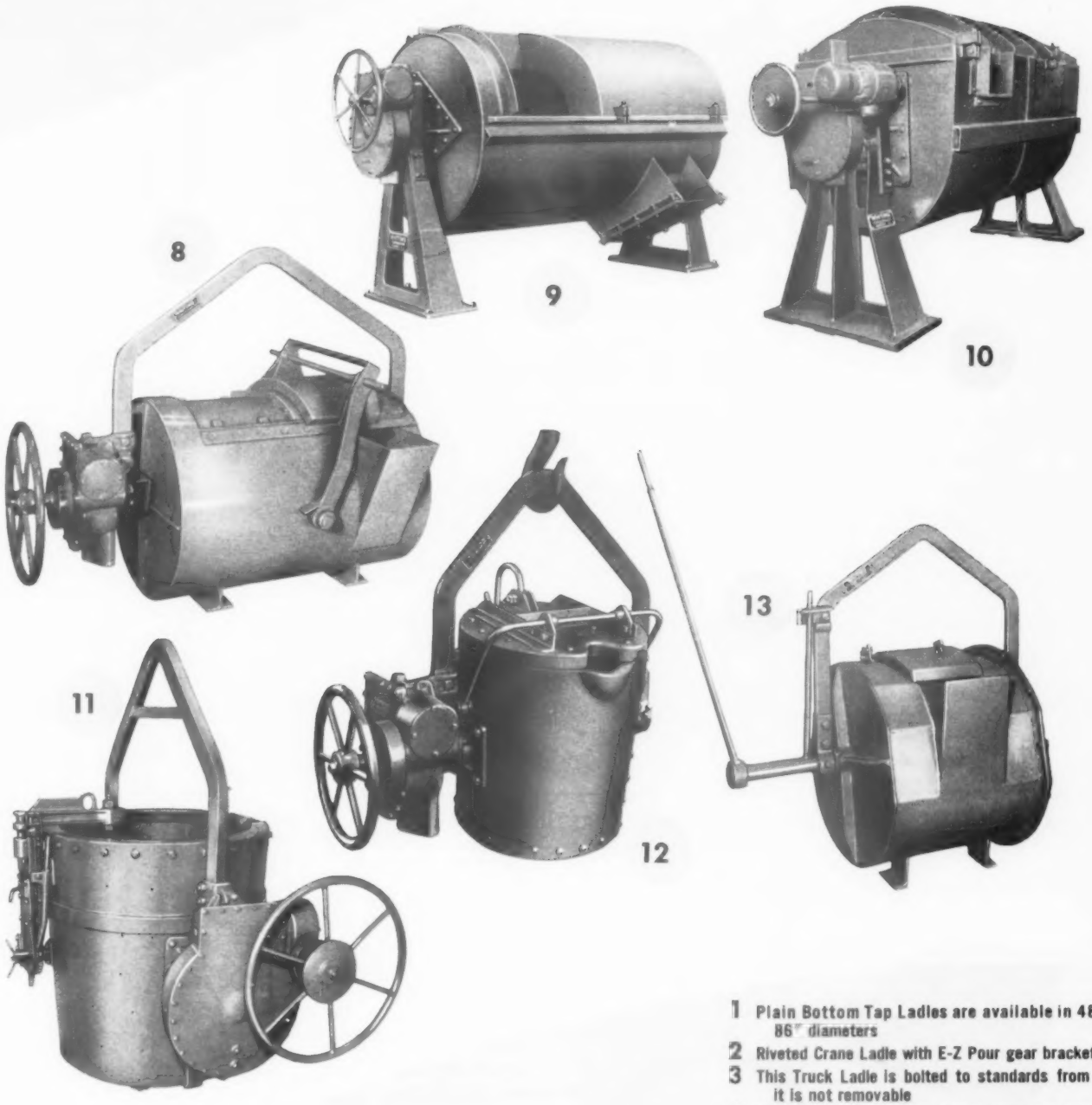
Whiting Ladles are built to provide easy, accurate pouring . . . to provide extra safety for workmen . . . and to give a long service life under the wear and tear of constant foundry use.

*Reg. U. S. Pat. Off.



Send for Bulletin FY-163

—simplify your operating problems



WHITING
CORPORATION

15607 Lathrop Ave. Harvey, Illinois

Offices in Chicago, Cincinnati, Detroit, Houston, Los Angeles, New York, Philadelphia, Pittsburgh, and St. Louis. Representatives in other principal cities. Canadian Subsidiary: Whiting Corporation (Canada) Ltd., Toronto, Ontario. Export Department: 30 Church St., New York 7, N. Y.

1 Plain Bottom Tap Ladles are available in 48½" to 86" diameters
2 Riveted Crane Ladle with E-Z Pour gear bracket
3 This Truck Ladle is bolted to standards from which it is not removable
4 Covered Trolley Ladle, hand lever tilt, has anti-friction bearing trunnions
5 Covered Trolley Ladles are available with straight or offset shank
6 Whiting Ladle Handlers assure safe, easy, accurate handling and pouring
7 Riveted Outside Teapot Spout Ladle with V-bail and E-Z Pour gearing
8 Geared Cylindrical Ladle has side-shifting cover, removable for relining
9 Whiting Reservoir Ladles are made in a variety of styles to meet any requirement
10 Whiting U-Ladle for mixing and desulfurizing, has motor-operated gear bracket
11 Geared Bottom Tap Ladles are available with choice of bottom tap rigs
12 Covered Crane Ladles provide longer retention of heat
13 Cylindrical Ladle with V-bail, hand lever tilt, hinged cover, and teapot spout

A new MULTI-PURPOSE UTILITY DRILL

FOR PLANT MAINTENANCE

A time-saver and a cost-saver for every plant maintenance crew — the new Gardner-Denver S17 Utility Drill is a full-fledged, self-rotating pneumatic hammer drill that weighs only 19 pounds. It's ideal for placing anchor bolts, for running conduit, cable, pipe, and for many other jobs.

Does a man-sized job — The lightweight S17 does a full day's work — without tiring the operator — thanks to balanced weight and power.

Unusually versatile — Drills concrete, brick or stone — with standard drill steel (⅞" hex. x 3¼"). Takes standard star drills — with star drill adapter. Converts to chipping hammer or pick — special feature stops rotation.

Safe and easy to use — Convenient hand-form "D" handle. "Safety First" trigger throttle. Easy hole starting — on partial feed position.

Other big S17 features — Standard ⅞" hex. x 3¼" chuck. Trouble-free coil-spring-type steel retainer. Effective lubrication from integral oil chamber. Also available with blower attachment and standard plug drill chuck for dimension stone work.

UTILITY DRILL KIT — IN HANDY CARRYING CASE

Includes complete S17 Utility Drill and accessories: 14" drill steel—three rock bits, sizes 1 $\frac{7}{16}$", 1⅜", 1 $\frac{5}{16}$" — star drill adapter —chuck driver lock pin— drift key—Allen wrench —end wrench—oil can— and 25 feet of ⅜" air hose, with fittings.

Try the new Gardner-Denver Utility Drill today—you'll want one for every maintenance crew in your plant.

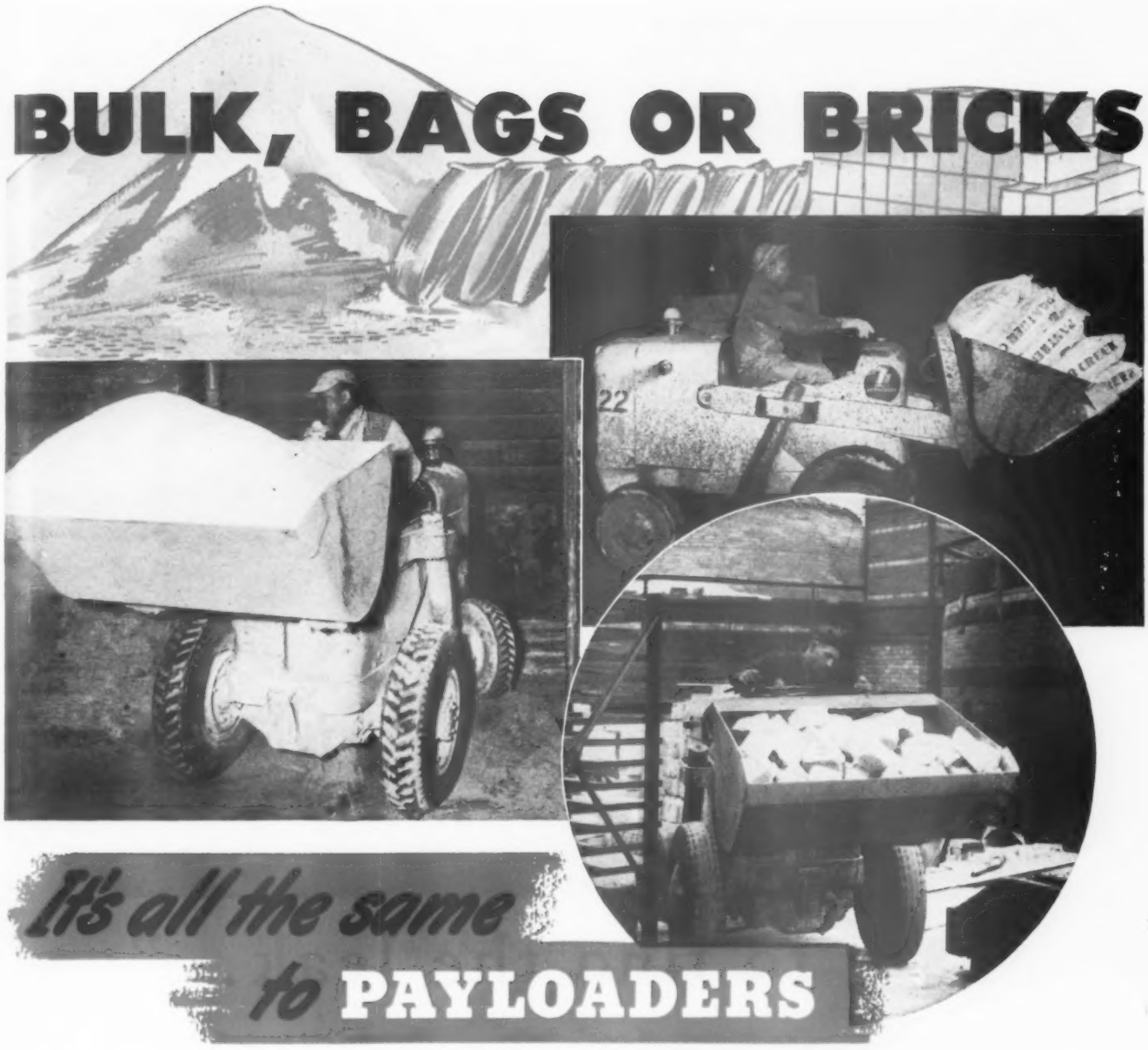
GARDNER-DENVER

Gardner-Denver Company, Quincy, Illinois.
In Canada: Gardner-Denver Company (Canada), Ltd., Toronto, Ontario.

USE COMPRESSED AIR FOR SAFETY CONVENIENCE FLEXIBILITY

Since 1859

BULK, BAGS OR BRICKS



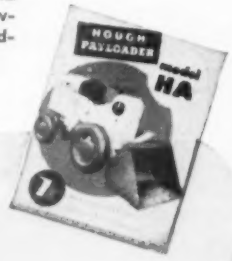
It's all the same to PAYLOADERS

Hundreds of "PAYLOADERS" are at work in foundries . . . saving time and labor, reducing costs, increasing production and adding flexibility to operations. They handle sand, slag, scrap, coke, limestone, waste, bricks, clay, etc. . . . they carry, dump, spread and windrow sand, and load trucks.

"PAYLOADERS" have the power and traction to scoop up big bucket loads of tough, lumpy, granular, sticky or abrasive materials . . . have the speed and maneuverability to carry their loads *fast* outdoors or indoors, over hard surfaces or ground, mud or snow . . . to work in close quarters, to unload box cars. They dump their loads directly into piles, trucks, cars, bins, containers or hoppers — high or low, slow or fast — by means of controlled hydraulic power.

It will pay you to get complete facts about unique unit-design "PAYLOADERS" and how they can serve you . . . facts based on Hough's 29 years of material handling experience and that of the world-wide Distributor Organization that sells and services them. The Frank G. Hough Co., 703 Sunnyside Avenue, Libertyville, Illinois.

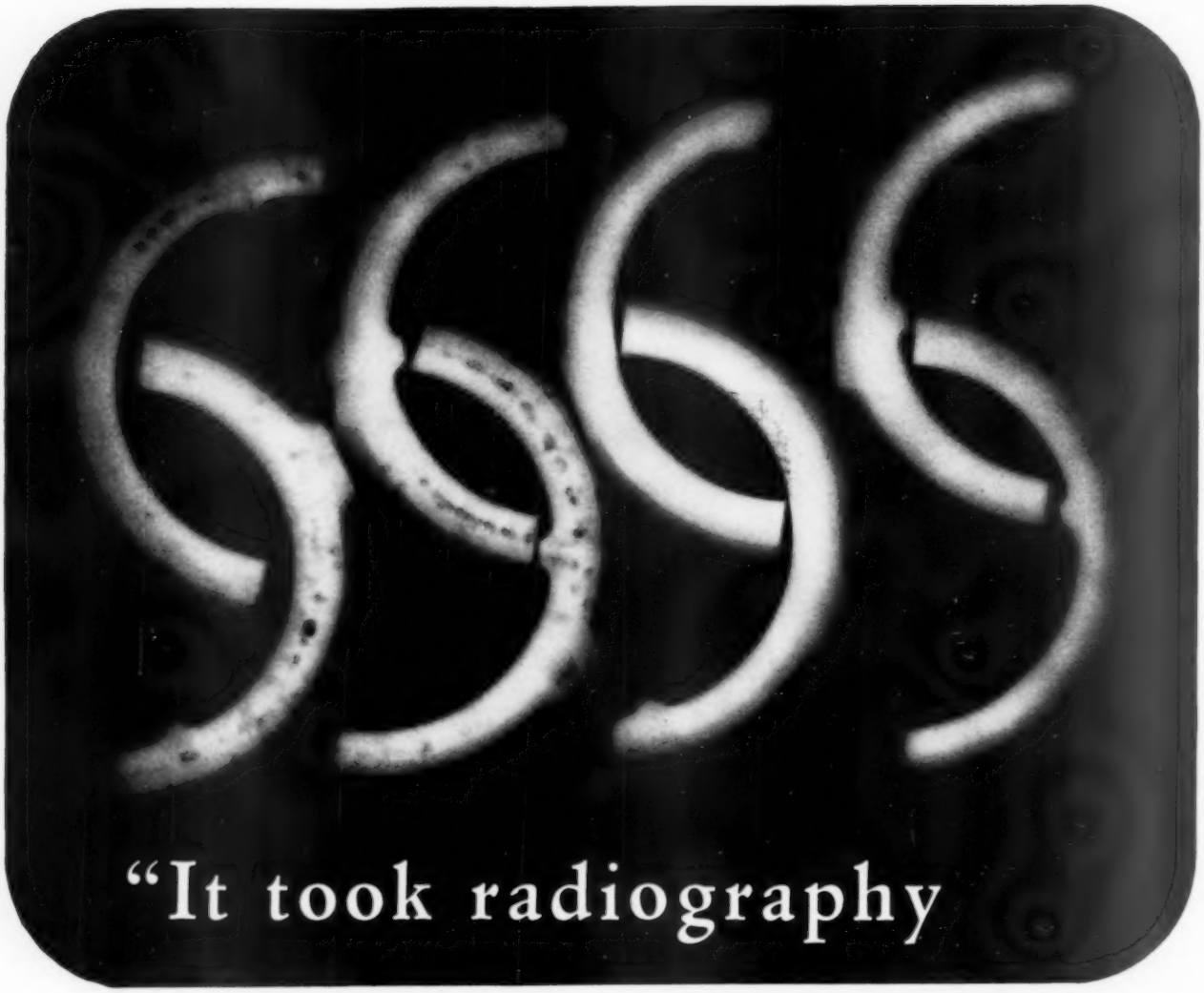
Catalogs about "PAYLOADERS" include many varied application photos and job data. They're yours for the asking, covering the 12 cu. ft. Model HA, the ½ yd. Model HE, the ¾ yd. Model HF, the 1¼ yd. Model HL, or the big 1½ yd. Model HM.



SAY "HUFF"

PAYLOADER®

Manufactured by THE FRANK G. HOUGH CO.



"It took radiography to find the leak..."

SO writes the inspection manager of one of the nation's leading manufacturers of valves and fittings. "We had a problem of porous valve seat ring castings showing up at the final test of valves," the inspection manager continued. "With the aid of our x-ray apparatus, defective castings were found to be porous and gassy, causing the leaks through the ring.

"After a thorough research, it was found the foundry technique required some changes, resulting in sound castings as shown on right of radiograph. A saving was effected in eliminating the machining, assembling and disassembling of unsound rings."

This company's experience is typical of scores of others who have found that radiography has become a *development* tool. It not only diagnoses, but suggests treatment. It shows where savings can be made, designs improved, new techniques developed.

Is there a place for industrial x-ray in your business? A General Electric X-Ray engineer will be glad to talk it over. Or write for Pub. 11A-3116 "Radiography as a Foundry Tool." Address General Electric X-Ray Corporation, Dept. YY8, Milwaukee 14, Wisconsin.

Find out how you can get x-ray inspection equipment under the GE Maxiservice Plan. No cash outlay. Monthly service charge covers everything. Write for folder.

GENERAL ELECTRIC
X-RAY CORPORATION

Make Parting Easier
Cut Rejects
Reduce Foundry Smoke

USE **"dag"** dispersions in your foundry because they:

IMPROVE PARTING by preventing adhesion of cast objects to mold cavities and cores.

CUT REJECTS and finishing costs because castings are reproduced in the finest detail. Films formed by **"dag"** dispersions are smooth . . . resistant to heat . . . extremely durable, and will not measurably affect mold tolerances.

REDUCE SMOKE and give men in the shop a break, because aqueous **"dag"** dispersions do not give off clouds of smoke and choking fumes.

Spray or brush it on chills, dies, patterns, ladle interiors and permanent molds. Eliminate binding and stripping, too, by using **"dag"** colloidal graphite to lubricate push pins, shoulder screws, flask pins, or any screw threads.

Acheson Colloids is equipped to do custom disintegrating, dispersing, and stabilizing of solids in a wide variety of vehicles. If you are in need of this type of service, tell us about it. We may be able to help you.

ACHESON COLLOIDS CORPORATION
Port Huron, Michigan

☐ Send me the NEW Foundry Bulletin #425

☐ Send an Acheson engineer

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STATE.....

H-11

dag DISPERSIONS

Acheson Colloids Corporation, Port Huron, Michigan

... also Acheson Colloids Limited, London, England

Newest Achievement in CARL-MAYER VERTICAL CORE OVENS

AND CONTINUOUS MONORAIL CORE OVENS

•

Carl-Mayer Vertical Core Ovens, with the heating system described, are protected by Patent No. 2,257,180. Other patents pending.

Vertical Ovens (Figs. 1 and 2) are by Carl-Mayer, using the universally adopted recirculating heating system with sealed combustion chamber located between conveyor chains.

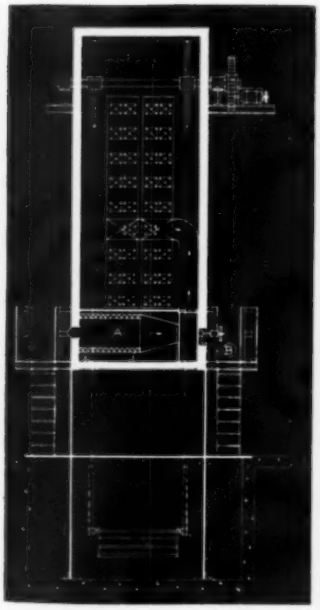


Fig. 1
NEW METHOD with heat fan inside oven.

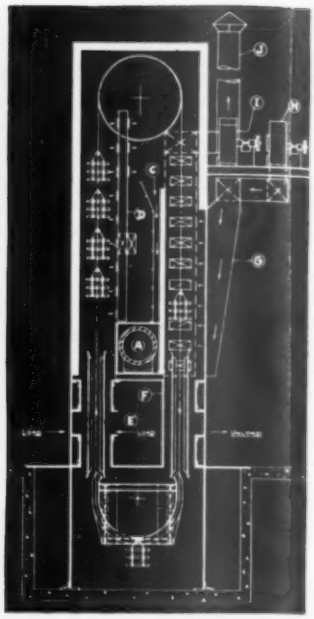


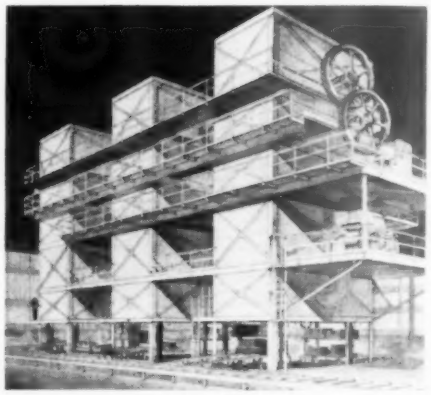
Fig. 2
Section showing conveyor travel thru pass, heating, cooling and exhaust system.

CONSIDER THIS HIGHLY IMPORTANT NEW DEVELOPMENT OF LOCATING THE HEAT FAN INSIDE OF OVEN (Fig. 1)

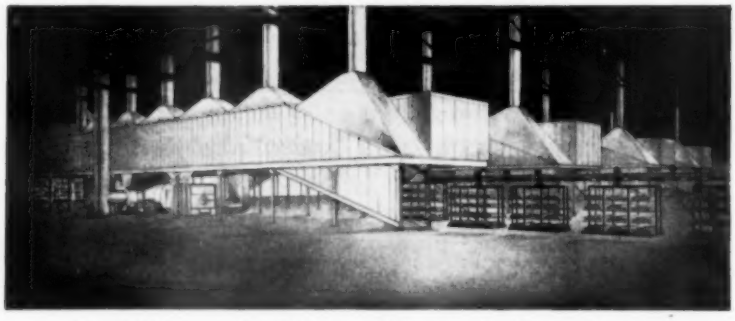
New added features are as follows:

(1) Saves platform space.
(2) Eliminating external duct reduces heat losses.
(3) Placing heat fan in oven also reduces heat losses, resulting in high operating efficiency.
(4) Elimination of external heat duct and fan insulation results in lower installation cost.
(5) Oven appearance is greatly improved and smoking eliminated from external heat ducts.

***Write for full description** of this and other vertical oven features guaranteeing faster baking, lower fuel consumption, smaller core losses, safer operation, **elimination** of smoke, **cooled cores at unloading station**, reduced labor cost.*



Three outstanding Carl-Mayer Vertical Ovens at General Steel Castings Corp. Each oven is 67′ high, 80 tons per bake per oven.



Carl-Mayer Continuous Monorail Core Ovens
Patent No. 2,355,814

One of the largest Monorail installations in the U. S. A. (patent no. 2,355,814) made for the Ford Motor Company. Each oven is 170′ long, utilizing 1,200 feet of continuous monorail conveyor. Some of the outstanding advantages of these ovens are:

(1) Flexibility in core handling, bench to core rack.
(2) Uniform, fast baking, using the "Mayer" convection heater.
(3) Cores can be removed with bare hands at unloading station using Carl-Mayer patented design.
(4) Smoke nuisance is eliminated.

Typical Users of CARL-MAYER VERTICAL AND MONORAIL OVENS

Aluminum Co. of America
Burt Foundry Co.
Cadillac Motor Co.
Eclipse Aviation Corp.
Electric Autolite Co.
Ford Motor Co.
Fremont Foundry Co.
General Motors Corp.
General Steel Castings Co.
Harrison Radiator Co.
Henry Kaiser
H. B. Salter Co.
McKinnon Industries
Quality Castings Co.
Packard Motor Co.
Richmond Radiator Co.
Union Brass and Metals Mfg. Co.
West Michigan Steel Castings Co.
A. C. Williams Co.

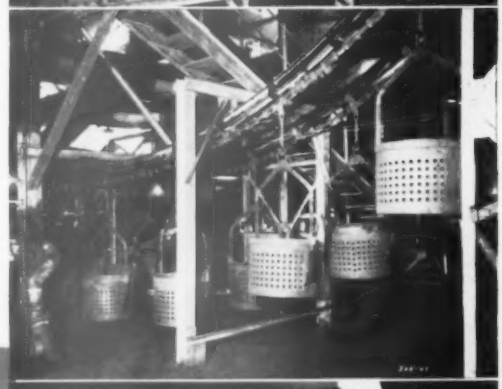
THE CARL-MAYER CORPORATION

3030 Euclid Ave., Cleveland, Ohio

Core and Mold Ovens—all types. Backed by over 30 years' experience

CALL FOR A JEFFREY ENGINEER

He's a Specialist



Yes, Jeffrey Foundry Engineers know their business . . . they have designed and equipped some of the largest foundries in this country. At the same time, they do not lose sight of the fact that small foundries need mechanized equipment to do a better job economically. They serve both—constructively.

You can put your modernization program squarely up to Jeffrey Foundry Sales Engineers. They will be glad to submit recommendations . . . to help you mechanize for profit. Photos shown here depict just a few of the large jobs engineered and erected by Jeffrey. Names upon request. Let us hear from you—if you want the right answers.

- Aerators
- Flask Fillers
- Mold Conveyors
- Feeders
- Screens
- Transmission Machinery
- Bucket Elevators
- Crushers
- Sand Preparation Equipment
- Sanditioners
- Apron & Belt Conveyors

THE JEFFREY MANUFACTURING COMPANY

ESTABLISHED 1877

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Jeffrey Mfg. Co., Ltd., Head Offices & Works: Montreal

Complete Line of Material Handling, Processing and Mining Equipment

SPECIAL SHAPES . . .

Unretouched photo.

Pre-fitting and inspection of a Taylor Sillimanite (TASIL) Electric Furnace Roof prior to shipment from the Chas. Taylor plant.

Custom Taylored

HERE'S THE PATTERN OF
Taylor service

1. Determine the right composition and structure to meet your service requirements.
2. Select the most efficient and economical method of forming.
3. Produce under strict control.
4. Fire in modern periodic or tunnel kilns.
5. Finish, assemble and mark to identify.

HERE'S THE RESULT
for you!

1. A shape or complete assembly engineered for *your* job.
2. *Time saved*—pre-fitting means quick, accurate installation with minimum cutting and fitting on the job.
3. *Money saved*—through lower masonry cost; longer refractory life; uninterrupted production.

For 86 years we've been making shapes for every metallurgical need—large and small, simple and complex. Entrust your next special shape order for Taylor Sillimanite (mullite), TACOR (corundum) and Taylor Zircon to Chas. Taylor. You'll know it will be made to your specifications and satisfaction. See your *Taylor* representative.

The CHAS. TAYLOR SONS Co.
MANUFACTURERS OF REFRACTORIES • CINCINNATI • OHIO • U.S.A.

Exclusive Agents in Canada:
REFRACTORIES ENGINEERING AND SUPPLIES, LTD.
Hamilton and Montreal

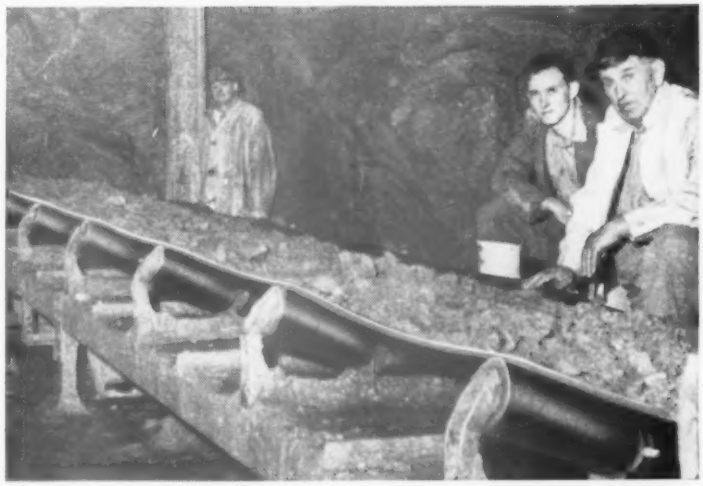
For heavy duty conveyors–

IT'S TIMKEN®...

Time and time again the advantages of Timken® tapered roller bearings have been proved for heavy duty conveyor belt idlers. For over 25 years, Timken bearings have been assuring long, trouble-free idler life to conveyor operators. For instance, this installation at the Rail-to-Water Transfer Company, Chicago, has carried approximately 8 million tons of coal since 1943. Not one of the Timken bearing equipped idlers made by Webster Manufacturing, Inc. has needed repair or replacement to date.

AND TIMKEN...

Timken bearing equipped idlers made by the Stephens-Adamson Manufacturing Company help bring gold ore to the surface at the 7,500 foot deep Marievale Consolidated Mines, Johannesburg, South Africa. Timken bearings take both radial and thrust loads in any combination. Idlers turn freely, belt wear is reduced to a minimum. Effective seals keep lubricant in and moisture out. Maintenance time and materials are saved.



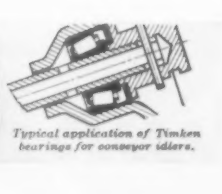
AND TIMKEN AGAIN!

Three 24″ conveyors totalling 150 feet in length were installed last year at this large crushing and screening plant in Vassalboro, Maine. 210 Timken bearings in 45 Pioneer Engineering Works, Inc. idlers help keep it running smoothly. On conveyors and throughout all industry, Timken bearings are first choice. There's no other bearing with so much to offer—no other bearing so fully proved! The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO".

Wherever the going's tough industry turns to

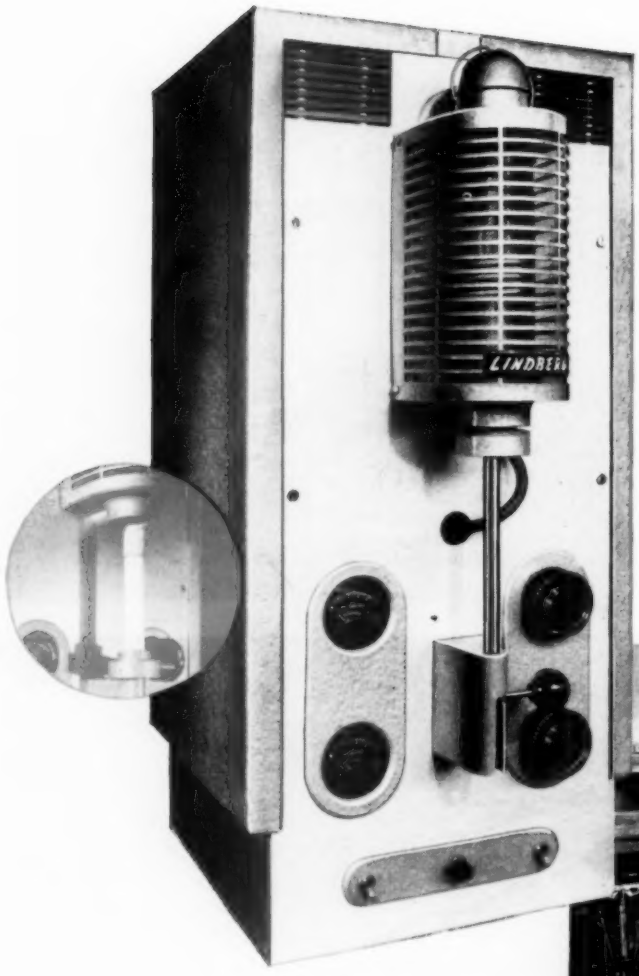
TIMKEN

TAPERED ROLLER BEARINGS



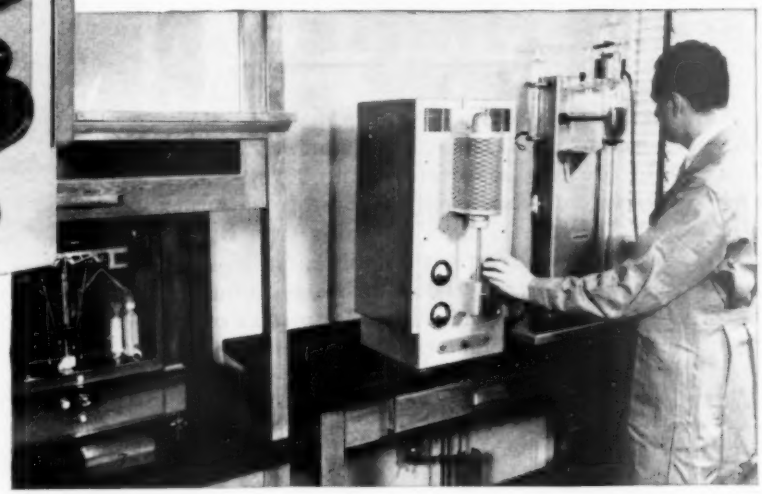
Typical application of Timken bearings for conveyor idlers.

NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER — BEARING TAKES RADIAL AND THRUST ▭ LOADS OR ANY COMBINATION



INSTANT IGNITION

of Solid Samples



Typical laboratory installation. A Lindberg Volumetric Carbon Determinator operating with a Lindberg "H-F" Combustion Unit

The Lindberg "HF" Combustion Unit is revolutionizing carbon and sulphur determinations in laboratories throughout the country. Ready for instant use—instant temperatures above 3000° F.—for steel, cast iron, alloys, or stainless samples—volumetric or gravimetric!

A high frequency unit specially designed for the laboratory

- Ready in the morning in 57 seconds—instantly from then on.
- 90% less power consumption (maximum input 0.125 KW idling).
- Glass combustion tube provides visability of operation.
- Combustion tubes at half the cost, last many times longer.
- Shorter tubes advantageous for volumetric method.
- No elements to burn out or limit temperatures.
- Heats nothing but the sample.
- Eliminates excess heat from the laboratory.
- Inexpensive "cupelet" holds full factor weight for carbons.
- Small and compact—13" wide—28½" high—17" deep.

For further details ask for Bulletin 910.

LINDBERG LABORATORY DIVISION

2453 WEST HUBBARD STREET · CHICAGO 12, ILLINOIS

SLASHES CORE COSTS!

Cuts Core Making Time from Days to Minutes

HERE'S A REVOLUTIONARY new way of making cores in one step. It replaces the time consuming steps of the conventional core making process shown in the drawing above. Cores can now be dried in minutes instead of hours . . . and cooling, curing and storage are not needed. It means savings of time, space and labor.

Instead of placing cores on collecting racks, core maker places them directly onto moving conveyor belt of *Foundromatic* Sand Core Dryer. *One step eliminated!* Cores come out of dryer a few minutes later cool enough to be handled with bare hands, and can go directly to the molder. *Two more steps eliminated.* Cuts out cooling rack, and storage rack. Reduces handling, breakage and floor space.

In addition, you'll enjoy speed and cleanliness. It takes up to 80% less time to dry cores — and they all come out perfect — without overbaking. Burning of fins or thin sections is eliminated! Working conditions improved too. Fumes and heat are gone from the core room. And in addition, you'll save 30 to 60% on fuel.

For complete information, outline your requirements to your nearby A-C Sales Office, or send in the coupon.

Foundromatic is an Allis-Chalmers trademark.

ALLIS-CHALMERS

ALLIS-CHALMERS, 1032A SO. 70 ST.
MILWAUKEE, WIS.

Please send me information on the *Foundromatic* Sand Core Dryer.

Name.....

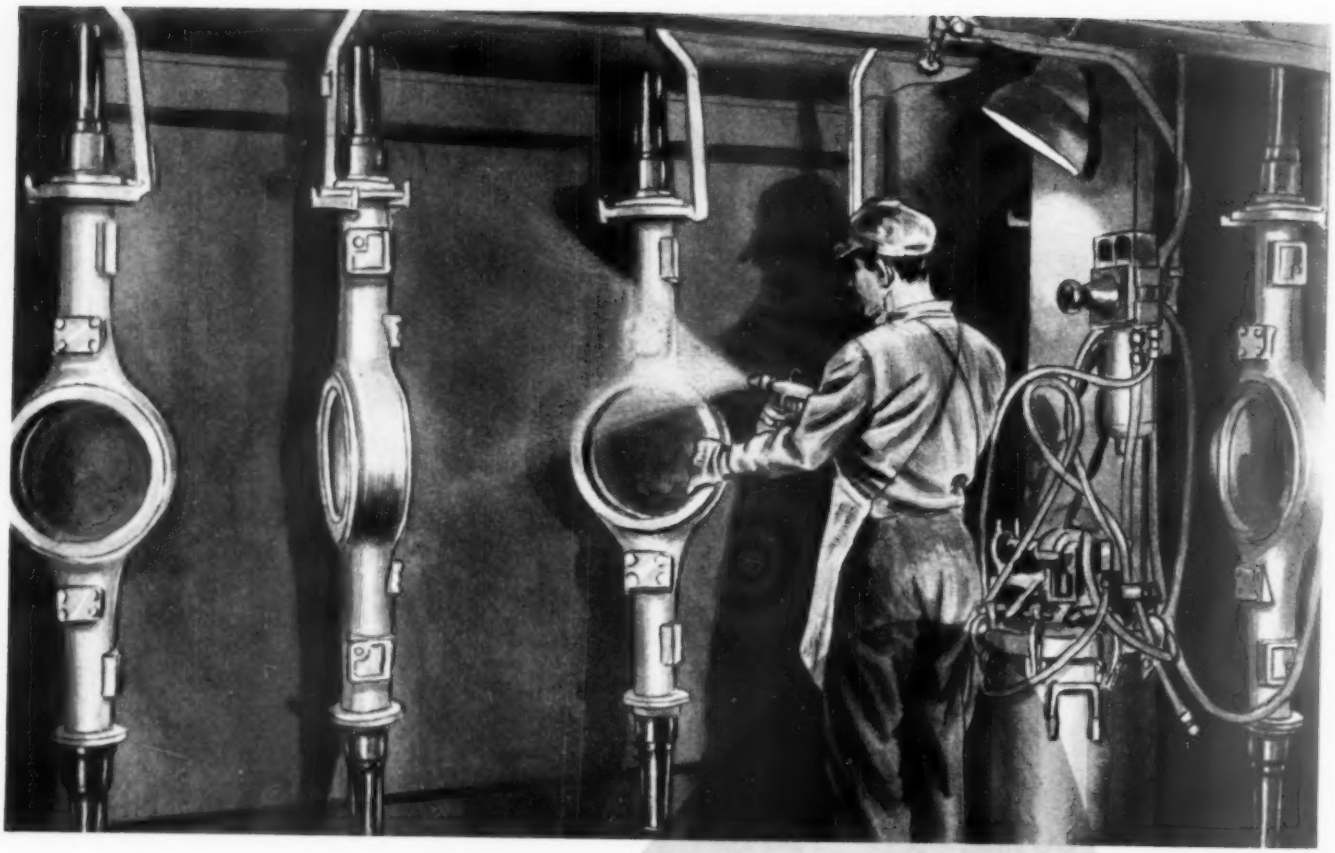
Title.....

Company.....

Street.....

City..... State.....

A-3085



axle housings

THE CASTING SEALER used on axle housings is subjected to rough treatment, both inside and out. Hot oil, vibration, friction, abrasion, rust—are constantly working to break down the protected surfaces. Such a sealer must be resistant to each of the above, and, in addition, must be non-bleeding and non-toxic.

The Tousey Varnish Company has developed such a product—and it is being used successfully by manufacturers of axle housings.

If your problem is one where a casting sealer is concerned—write Tousey Varnish today — it is quite possible we have a formula that will fit your specifications—if not—our laboratory is set up to work out the answer.

Read about the organization behind Tousey finishes. A copy of our new book "65 YEARS OF ACHIEVEMENT" is yours for the asking.

TOUSEY PRODUCTS
CASTING SEALER

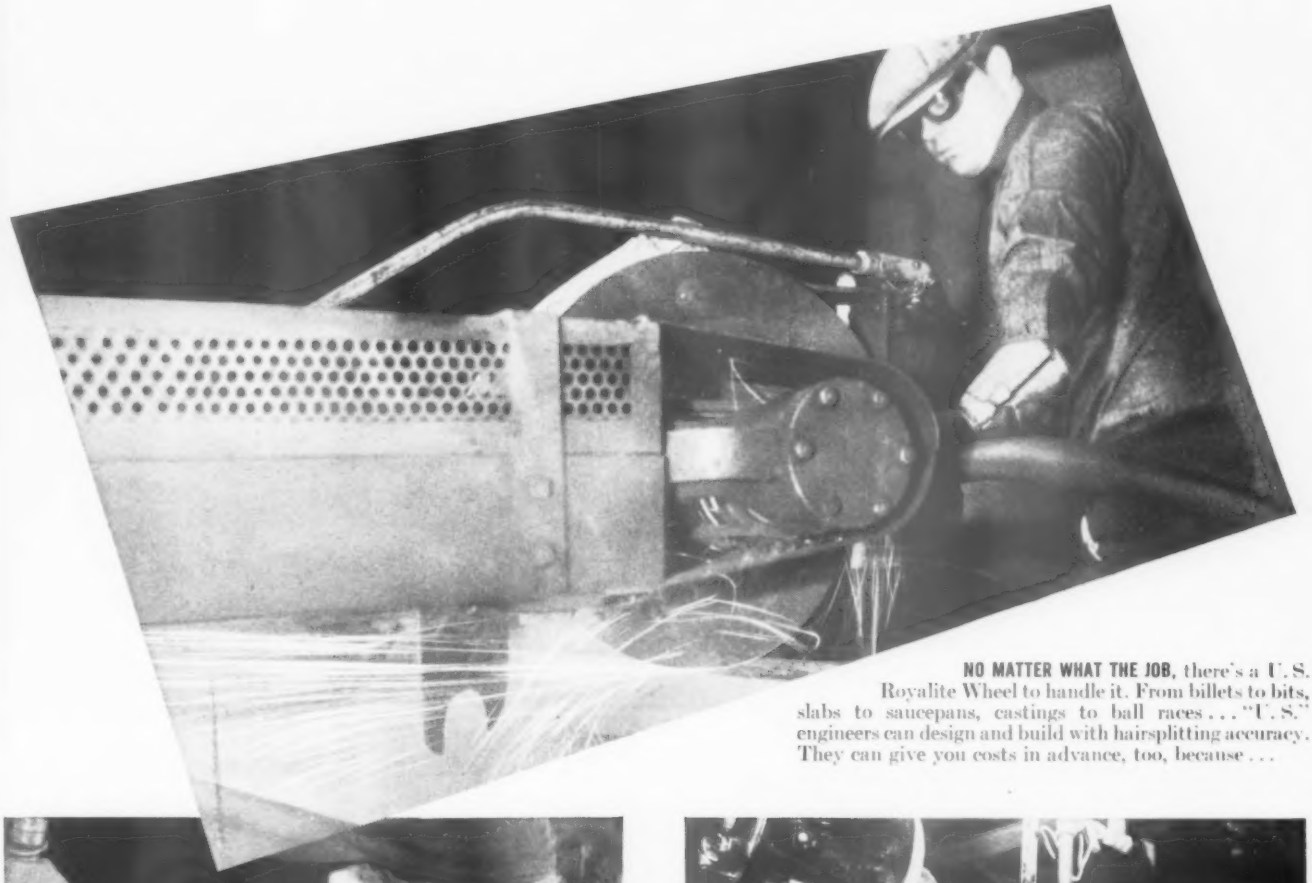
TOUSEY FINISHES CAN TAKE IT!

TOUSEY VARNISH CO.

520 WEST 25TH STREET, CHICAGO 16, ILLINOIS

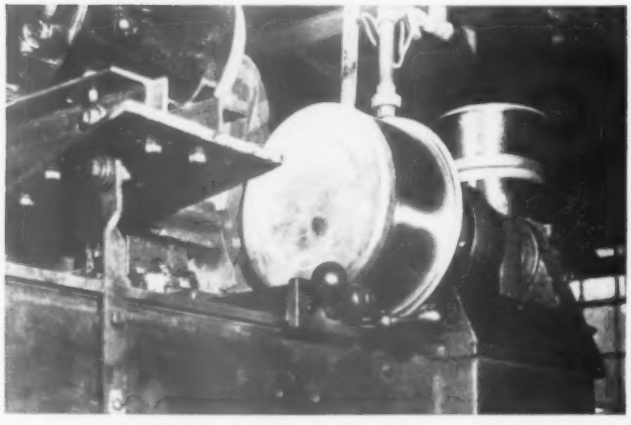
ACCURATE GRINDING WHEEL COSTS...IN ADVANCE!

86 years' experience in bonds and abrasives enables "U. S." Engineers to eliminate all guesswork in filling your specifications



NO MATTER WHAT THE JOB, there's a U. S. Royalite Wheel to handle it. From billets to bits, slabs to saucepans, castings to ball races . . . "U. S." engineers can design and build with hairsplitting accuracy. They can give you costs in advance, too, because . . .

BY MEANS OF TESTS right in your own plant, backed by 86 years of experience, they remove all guesswork. "U. S." facilities permit complete and positive testing to make sure you get the right wheel, whether the function is unusual or routine.



IF YOUR OPERATING CONDITIONS change, "U. S." technicians can very often come up with the right answer *in a hurry*, even when it means filling specifications never before demanded in a grinding wheel.

Bring your grinding wheel problems to U. S. engineers. Let them study it, let them make tests. They will make sure you receive properly engineered wheels in which you can have complete confidence.

A PRODUCT OF

U.S.RUBBER

SERVING THROUGH SCIENCE

UNITED STATES RUBBER COMPANY

GRINDING WHEEL DEPARTMENT • ROCKEFELLER CENTER, NEW YORK 20, N. Y.

THE HINES

3431 WEST 140th ST.

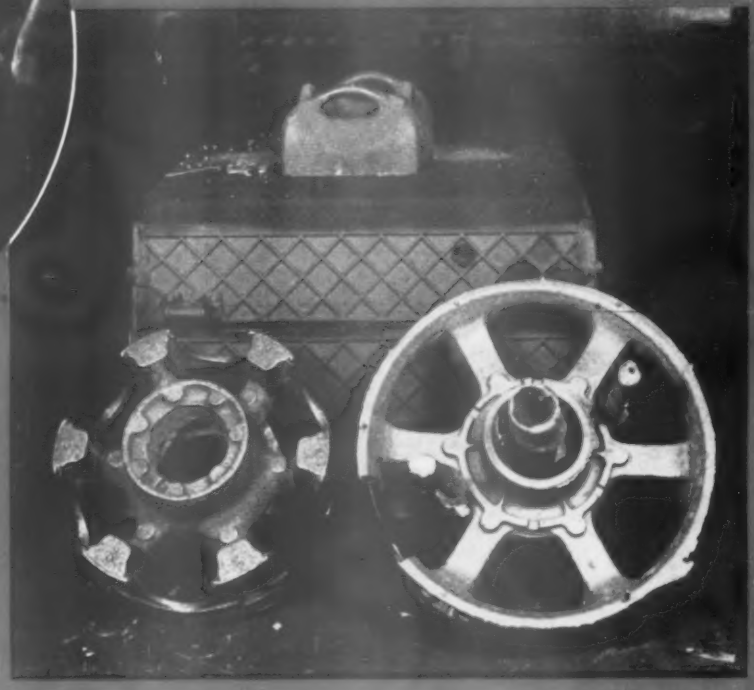
Another Good Example of

Large, Heavy Castings Being Made in

HINES *"Pop-Off"* FLASKS

and poured off in

HINES JACKETS



All Hines Flasks and Jackets are fully protected by patents and patents pending.

S FLASK CO.

CLEVELAND 11, OHIO

Coke plant producing high quality metallurgical coke purchased by **Great Lakes Carbon Corporation**

Customers of former Laclede Gas Light Company Coke Plant, St. Louis, Mo., are assured of steady supply of coke and other products

We are pleased to inform the trade of our purchase from the Laclede Gas Light Company of its well-known St. Louis Coke Plant. We will, of course, continue to meet the supply requirements of the plant's customers.

The Coke Plant has 56 Koppers ovens and 8 Piette ovens capable of producing some 250,000 tons of high quality metallurgical coke a year. Other products consist of coal tar, ammonium sulphate, nitration and industrial pure grades of benzol, toluol, zylol, crude light and heavy solvent, and crude still residue.

The plant's production will be continued under the direction of Mr. E. W. Blind, superintendent; Mr. John Adolphson, assistant superintendent, and Mr. Joseph Kohlberg, chief chemist. We take considerable pleasure in informing you that these men, who have been with the plant many years and who are well-known throughout the industry, will remain with us and continue in their former capacities.

Great Lakes Carbon Corporation has been identified with coke and coal operations for more than 30 years. We are regarded as one of the largest and most dependable suppliers of calcined petroleum coke in the world. The products of the St. Louis Coke Plant are exceptionally well related to our other activities. We look forward to serving the plant's customers, many of whom are already acquainted with our other products.

GLC **Great Lakes Carbon Corporation**

NEW YORK • CHICAGO • LOS ANGELES • *Executive Offices:* 18 EAST 48TH STREET, NEW YORK 17

CARBON DIVISION

Petroleum coke
Calcined petroleum coke
Industrial carbons

OIL AND GAS DIVISION

Crude petroleum and natural gas

BUILDING PRODUCTS DIVISION

Lightweight aggregates for plaster and concrete, marketed under the registered trade name PERMALITE

ELECTRODE DIVISION

Graphite and amorphous carbon electrodes. Graphite anodes. Carbon and graphite specialties.

DICALITE DIVISION

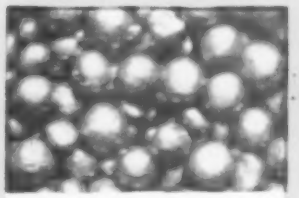
Diatomaceous silica marketed under the registered trade name DICALITE

Let American be your partner

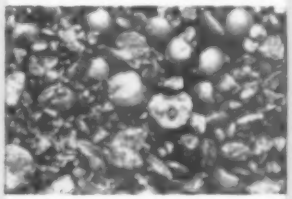
The three most important words here at **American** are these: **Deserve the business!** This is a challenge that we accept without compromise or reservation. It is the spur that keeps us ever on the alert to new ways of improving the quality and performance of our products; of helping customers to do a better job at less cost; and of continuing our record of being the FIRST in our field to contribute new and improved products and processes. We believe the way to 'deserve the business' is to serve our customers as though we were a partner in their organization.

TRU-STEEL saves 79%

Casting Service Co. uses 79% less shot when TRU-STEEL is used. SAVINGS are effected in storage space, transportation costs, machine maintenance, loading time, replacement parts.



TRU-STEEL
No. 230 at Mag. 10X
After 1,500 Passes



CHILLED IRON
No. 230 at Mag. 10X
After 50 Passes

Accurate performance records at Casting Service Co., LaPorte, Indiana prove the cost-saving advantages of TRU-STEEL Shot over chilled iron abrasive in cleaning gray iron castings. A test was conducted for a period of 69 wheel hours with the following results:

SHOT USED PER WHEEL HOUR

Chilled Iron	34.7 lbs.
TRU-STEEL	7.14 lbs.
SAVING (69 Wheel Hours)	1901.64 lbs.

American WHEELABRATOR & EQUIPMENT CORP.
505 S. Byrkit St., Mishawaka 2, Indiana

PLEASE TURN PAGE

CASE HISTORY No. 20

WHEELABRATOR®

BEFORE WHEELABRATING

AFTER WHEELABRATING

American

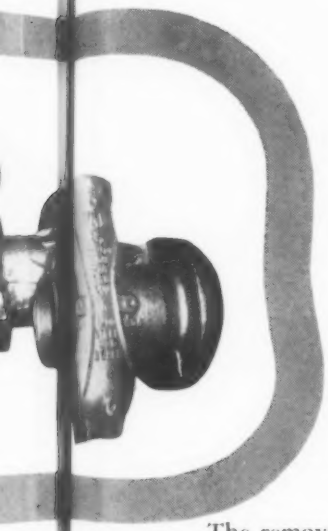
WORLD'S LARGEST BUILDER OF

PLEASE TURN PAGE

SAVES $15,980 in 1 YEAR

for KEY COMPANY, E. St. Louis, Illinois

WHEELABRATOR TUMBLAST REPLACED TWO MACHINES AND OVERCAME FIVE MAJOR PROBLEMS



1. **Eliminated excessive maintenance costs (Repair parts and labor).**
2. **Eliminated second shift and reduced labor requirements 66 2/3 %.**
3. **Reduced use of compressed air for cleaning, releasing it for other operations.**
4. **Eliminated abrasive waste and reduced abrasive consumption.**
5. **Eliminated production bottlenecks.**

The removal of heat treat scale from steel castings in the cleaning department at Key Company was a stumbling block to full scale, profitable production. Excessive cleaning time prevented the cleaning department from maintaining the same production as the rest of the plant.

When Key Company, producers of carbon and alloy steel castings, installed a Wheelabrator Tumblast their scale removal problems were reduced to a minimum. This high speed machine now cleans in a single shift all parts that formerly required two shifts and two machines. It has reduced operating costs $15,980.40 in a single year. In addition it has a profound effect on the profitable operation of the entire plant.

This is not an isolated example but is typical of the results the Wheelabrator is achieving for manufacturers all over America. You can't afford to pass up these savings for your plant. Write today for full information.

COST COMPARISON CHART

	FORMER METHOD	WHEELABRATOR METHOD
MACHINE	Airblast Room and a Blast Mill	48" x 72" Wheelabrator Tumblast (30 cu. ft. operating capacity)
PRODUCTION	3650 tons annually	3650 tons annually (cleaned in both annealed stage plus finish cleaning on bulk of castings)
LABOR requirements	48 man hours daily	16 man hours daily

SAVINGS: **DAILY: $69.48** **MONTHLY: $1331.70** **ANNUALLY $15,980.40**

FOUNDRY EQUIPMENT MEMBER FEMA MANUFACTURERS ASSOCIATION

WHEELABRATOR & EQUIPMENT CORP. 505 S. Byrkit St., Mishawaka 2, Ind.

MANUFACTURERS OF AIRLESS BLAST EQUIPMENT

PLEASE TURN PAGE

Dustube SAVES operating expenses

uses less power—requires less maintenance—reduces dust collection costs to a minimum

Dustube costs less to operate than other collectors because of its simple cloth tube design. Ample spacing of these filters keeps back-pressure to a minimum and reduces power costs. Carefully engineered hood designs keep the volume of air to a minimum to effect savings in initial and operating costs.

Dustube lowers maintenance costs, too, because there are no complicated parts to wear out. You can determine the condition of the tubes from a central walkway on the clean air side. Filter tubes can be replaced by one man without tools in a few minutes.

Though it costs little to operate, Dustube collects even the finest dust particles with nearly 100% efficiency. Discharged air shows less than 10 million particles per cu. ft. from 2 to 10 microns in size, as determined by the impinger method.

DUSTUBE collects more dust at lower cost

See how it SAVES for Midstate Foundry Co., Charleston, Illinois

Mr. C. H. Bence, Vice President

"We consider our Dustube Collector to be a very profitable investment — all of the equipment in our cleaning room is ventilated at an exceptionally low operating cost. The Dustube was purchased because we felt the simple, practical design of the unit would provide the highest efficiency at the lowest cost. Our experience has justified the choice 100%."

Mr. Leo Trout, Maintenance Foreman

"For the amount of dust the Dustube handles daily, it is unbelievable how little attention it requires. We find it unnecessary to do more than inspect and frequently oil the few moving parts. There has been no cloth wear in the several years the unit has been installed. With such a favorable maintenance experience, the Dustube has my highest recommendation."

American CORE ROD STRAIGHTENER

SAVES 2000 MAN HOURS

cuts material costs in half

A Chicago Foundry slashed their material cost by 50% and eliminated 2,000 man hours per year with an American Core Rod Straightener.

Why invest in new rod stock when the bent ones can be straightened so inexpensively? The Core Rod Straightener operates as fast as rods can be fed to the machine. An attachment for making gaggers is optional. Write today for Bulletin No. 10-B.

American

WHEELABRATOR & EQUIPMENT CORP.
505 S. Byrkit St. Mishawaka 2, Indiana

PLEASE TURN PAGE

Model CH-20 Truscon Power Handled Flask.

Model CH-40 Truscon Flask for Extra Heavy Duty.

HEADQUARTERS
FOR STEEL FOUNDRY FLASKS

THE SUCCESS of modern foundry methods depends upon the speed and economy with which molding operations can be handled.

Truscon's Pressed Steel Division—nationally known for the quality of its products and the dependability of its service—is fully equipped and prepared to handle your foundry flask requirements. The Pressed Steel Division's central location assures efficient service for your needs. Write for free catalog describing the complete line of Truscon Steel Foundry Flasks.

TRUSCON
STEEL COMPANY
PRESSED STEEL DIVISION
6100 TRUSCON AVE. • CLEVELAND 4, OHIO
Subsidiary of Republic Steel Corporation

Model OM-1 Truscon Flask for One-Man Handling.

Model OM-4 Truscon Flask for One-Man Handling.

Model TMR-60 Round Truscon Steel Flask for Two-Man Handling.

Model TM-10 Truscon Flask for Two-Man Handling.

Model TM-12 Truscon Flask for Two-Man Handling.

For Greatest Efficiency
At Lowest Cost

DESULFURIZE
with
SODA ASH

For a Quality Soda Ash
At No Extra Cost

Specify **SOLVAY**
Trade-Mark Reg. U. S. Pat. Off.

DENSE SODA ASH

Especially Designed for Desulfurization

★ MEDIUM GRAIN SIZE ★ DUSTLESS ★ HIGH CHEMICAL PURITY

Simple, efficient, low-cost equipment for automatically feeding Soda Ash into molten iron for desulfurization is now available. We will be glad to supply detailed information concerning this equipment and its installation upon request.

SOLVAY SALES DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 Rector Street, New York 6, N. Y.

Cuts Core Handling—Storage!

Reduces Core Making Time From Days To Minutes

THE BIG SAVINGS you get by using the *Foundromatic* Sand Core Dryer stem chiefly from cutting storage space and handling labor. Just how big your savings could be depends on labor and overhead charges in your plant.

Add to this, fuel savings of 30 to 80% (depending on the type of binder you are now using) . . . plus a saving in drying time up to 80% and you begin to see the tremendous advantage of this revolutionary new system.

END OVERBAKING OF CORES

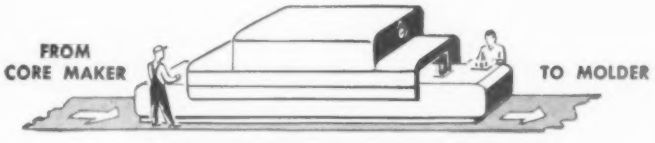
In addition, overbaking of cores is impossible. Ends burning of fins or thin sections of cores. Practically eliminates rejects.

Working conditions are improved too. Fumes and heat are eliminated from the core room, because all the heat that is generated goes into the core.

Any core that will pass through an aperture 36 inches wide and 13 inches high can be dried in the *Foundromatic* sand core dryer.

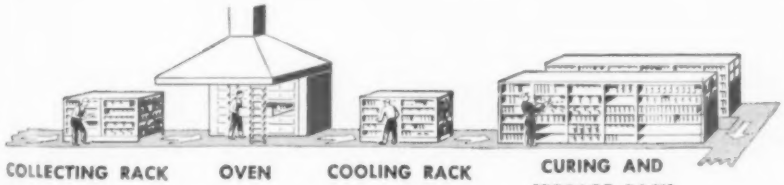
Allis-Chalmers engineers are prepared to help you. Their experience is based on several years of development work in A-C's huge foundries where electronic skills and real foundry practice were combined.

A-3097



FOUNDROMATIC CORE DRYER

FOUNDROMATIC DRYER WAY



OLD WAY

3 STEPS YOU CAN ELIMINATE

1. Eliminate collecting racks. Cores are placed directly onto the moving conveyor belt of the *Foundromatic* Sand Core dryer.

2. Eliminate cooling racks. When cores come out of dryer, they're cool enough to be handled bare-handed.

3. Eliminate curing and storage racks. Cores can be made as needed in a matter of minutes, without building stocks on curing and storage racks.

Foundromatic is an Allis-Chalmers trademark.

ALLIS-CHALMERS

ALLIS-CHALMERS, 1032A SO. 70 ST.
MILWAUKEE, WIS.

Please send information on the *Foundromatic* Sand Core Dryer.

Name.....

Title.....

Company.....

Street.....

City..... State.....

Quantity
PRODUCTION
of
GREY IRON CASTINGS

*

ONE OF THE NATION'S
LARGEST AND MOST MODERN
PRODUCTION FOUNDRIES

*

ESTABLISHED 1866

THE WHELAND COMPANY

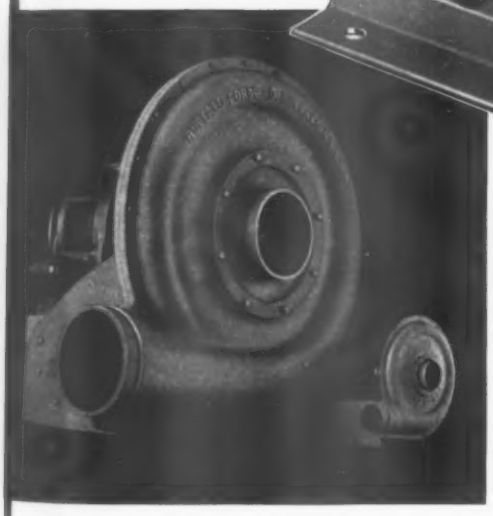
FOUNDRY DIVISION

MAIN OFFICE AND MANUFACTURING PLANTS

CHATTANOOGA 2, TENNESSEE

Rugged, Efficient CUPOLA BLOWER In A Small Package!

"Buffalo" TYPE "CB" PRESSURE BLOWERS



←"BUFFALO" "E" BLOWERS

For capacities up to 5500 c.f.m. and pressures up to 55.2″ of water, and a wide variety of smaller sizes, "Buffalo" Electric Blowers-Exhausters have constant characteristics over a wide range of capacity. Rugged, efficient, economically installed one-piece units.

WRITE FOR BULLETIN 3014-C

- *Single stage blowing*, 150 c.f.m. to 8000 c.f.m., up to 2¼ pounds pressure!
- Stronger, lighter, yet more efficient units than ever before!
- Dynamically balanced rotors of sturdy steel plate, riveted or welded—steel plate housing sides ribbed for extra strength!
- WRITE FOR BULLETIN 3553-A for complete description including dimensions and performance ratings.

"Buffalo" FIRST FOR FANS

BUFFALO FORGE COMPANY

221 MORTIMER ST. BUFFALO, NEW YORK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont., Branch Offices in all Principal Cities

VENTILATING FORCED DRAFT | AIR WASHING COOLING | AIR TEMPERING HEATING | INDUCED DRAFT EXHAUSTING PRESSURE BLOWING

Completely New and Proven Operating Principle

Custom Built in any Length, Width or Depth

ADAMS ALUMINUM EASY-OFF FLASK

These advantages will cut your production costs!

RIGID CONSTRUCTION through proven corner design, permits reduced weight without the loss of maximum strength.

SOLID CORNERS are of the same design used on Adams Aluminum Slip Flasks. This interlocking tongue-and-groove construction is retained in perfect alignment with bolts secured through tapped end sections and locked with washers and nuts. Important! This construction has proved superior to other forms of corner design.

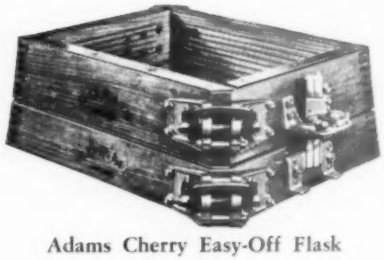
MALLEABLE TRIMMINGS are used on Adams Aluminum Easy-Off Flasks as on all other flasks we manufacture.

OPERATING MECHANISMS are identical with those used on the Adams Cherry Easy-Off Flask and incorporate the same simple adjustment and reversal of locking position.

ADJUSTMENTS are made only when the mechanism is in locked position.

ALUMINUM PROTECTING STRIPS are standard equipment at top of cope and bottom of drag. Steel strips available upon request at no extra charge.

HANDLES AND TRUNIONS are available when specified . . . at extra charge.



Adams Cherry Easy-Off Flask

Adams Jackets, Cast Iron or Aluminum

Adams Steel Jacket

• ***Write today for full details . . .***

Cherry Snap Flasks—Cherry Slip Flasks—Aluminum Slip Flasks—Easy-Off Flasks
Cherry Presser Boards—Wood Bottom Boards—Steel Bottom Plates—Steel Jackets
Aluminum or Cast Iron Jackets—Steel Bands—Steel Upsets—Cherry or Aluminum Upsets

The ADAMS Company

ESTABLISHED 1883

MOLDING MACHINES and FLASK EQUIPMENT

DUBUQUE, IOWA, U.S.A.

HAPPY DAYS ARE HERE AGAIN

when you use

SMITH L-O CORE OIL

The many advantages found in Smith L-O Core Oil result from constant research both in the laboratory and on the job. This is your guarantee of a binder unexcelled for superior strength, wide flexibility, absolute uniformity. Foundrymen who select Smith L-O for light as well as heavy work find jobs are easier-going when this high quality oil is a part of their production. Join with them and learn first hand how Smith L-O makes for "happy days" in the modern foundry of today!

MOLDED TO *Perfection*

SAND IS ONLY PART OF THE PICTURE

WAREHOUSE STOCKS AVAILABLE
In The Following Cities

- COLUMBIAN WAREHOUSE CO. Reading, Pennsylvania
- FOUNDRY SERVICE CO. Birmingham, Alabama
- E. R. FROST CO. Minneapolis, Minnesota
- F. F. SHORTSLEEVE Elmira, New York
- MALCOLM G. STEVENS Arlington, Massachusetts
- PACIFIC GRAPHITE CO., INC. Los Angeles 22, California
- TERMINAL WAREHOUSE Worcester 8, Massachusetts
- M. W. WARREN COKE CO. St. Louis, Missouri
- WESTERN FOUNDRY SAND CO. Seattle, Washington
- WESTERN INDUSTRIAL SUPPLY CO. Portland 14, Oregon

Smith L-O Core Oil

ROD DIP LIQUID PARTING

SMITH OIL & REFINING CO.

MANUFACTURERS OF L-O AND CERTIFIED CORE OILS

INDUSTRIAL OILS DIVISION . . . ROCKFORD, ILLINOIS

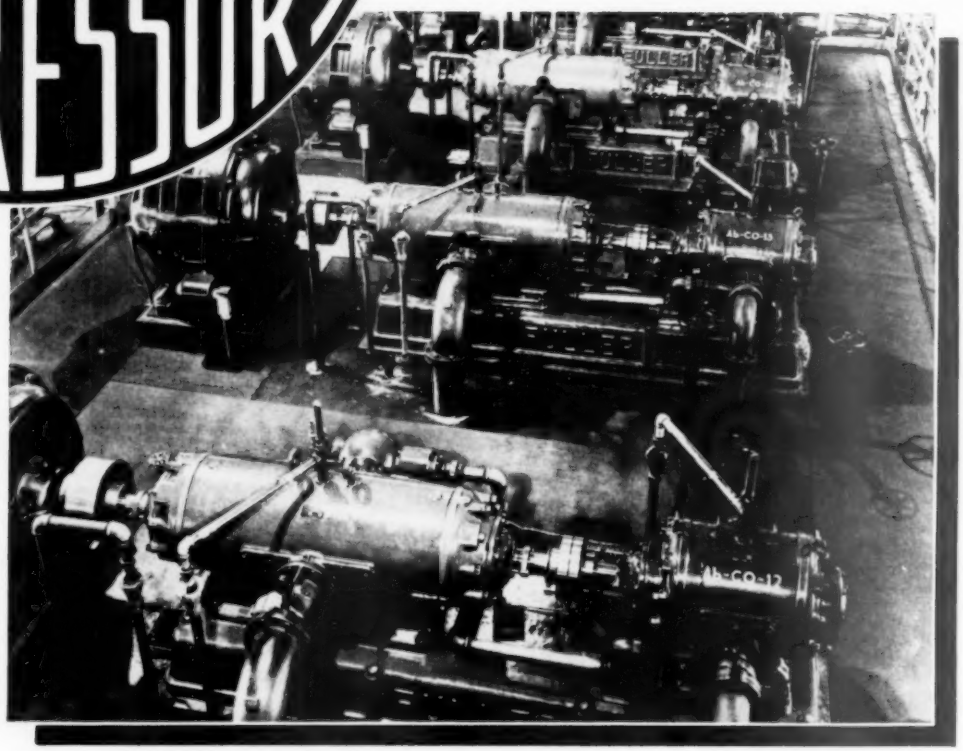
FULLER ROTARY COMPRESSORS

For

100-125-LB. PRESSURE

3300 C.F.M

ACTUAL FREE-AIR DELIVERY



Four Fuller Rotary Two-stage Compressor installation.

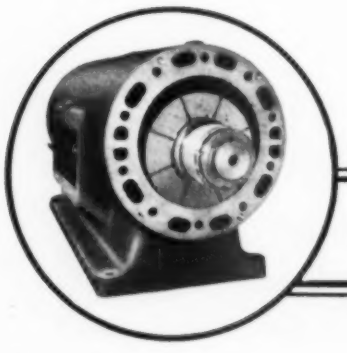
Capacity each, 1665 c.f.m., 100-lb. pressure.

Maybe you are one of those who has the impression that Fuller Rotary Compressors are built only for low-pressure service. Fuller Rotary Two-stage Compressors have been built, and installed, for many years for pressures up to 100 and 125-lb. gage. These high-pressure machines are just as dependable as the single-stage machines for the lower range of pressures.

For example, one of the largest manufacturers in this country has purchased and installed, during the past ten years, 43 Fuller Rotaries, of which number, 37 are of the two-stage high-pressure design; another company installed 12, of which seven are for high pressure; another installed six, all for high-pressure operation.

We are continually selling and manufacturing these high-pressure machines, and would welcome an opportunity to discuss Fuller Rotary Compressors with you.

No. 3 of a series



FULLER COMPANY, CATASAUQUA, PA.

CHICAGO 3 - 120 SO. LASALLE ST.

SAN FRANCISCO 4 - 420 CHANCERY BLDG.

A LIFETIME OF NEW MACHINE EFFICIENCY

C-193

FLY-ASH COSTS YOU MONEY...

in good-will... in expensive repairs!

THE WATER CURTAIN

CUPOLA COLLECTOR

WILL CLEAN-UP YOUR OPERATION

Fly-ash from your cupola can be a costly nuisance.

The deteriorating action on house paint, roofs, gutters on property adjacent to your plant may develop into a serious public relations problem.

Fly-ash is indeed expensive when it destroys your own facilities and requires repair or replacement of roofs, window sash, gutters, stacks, motors and other equipment.

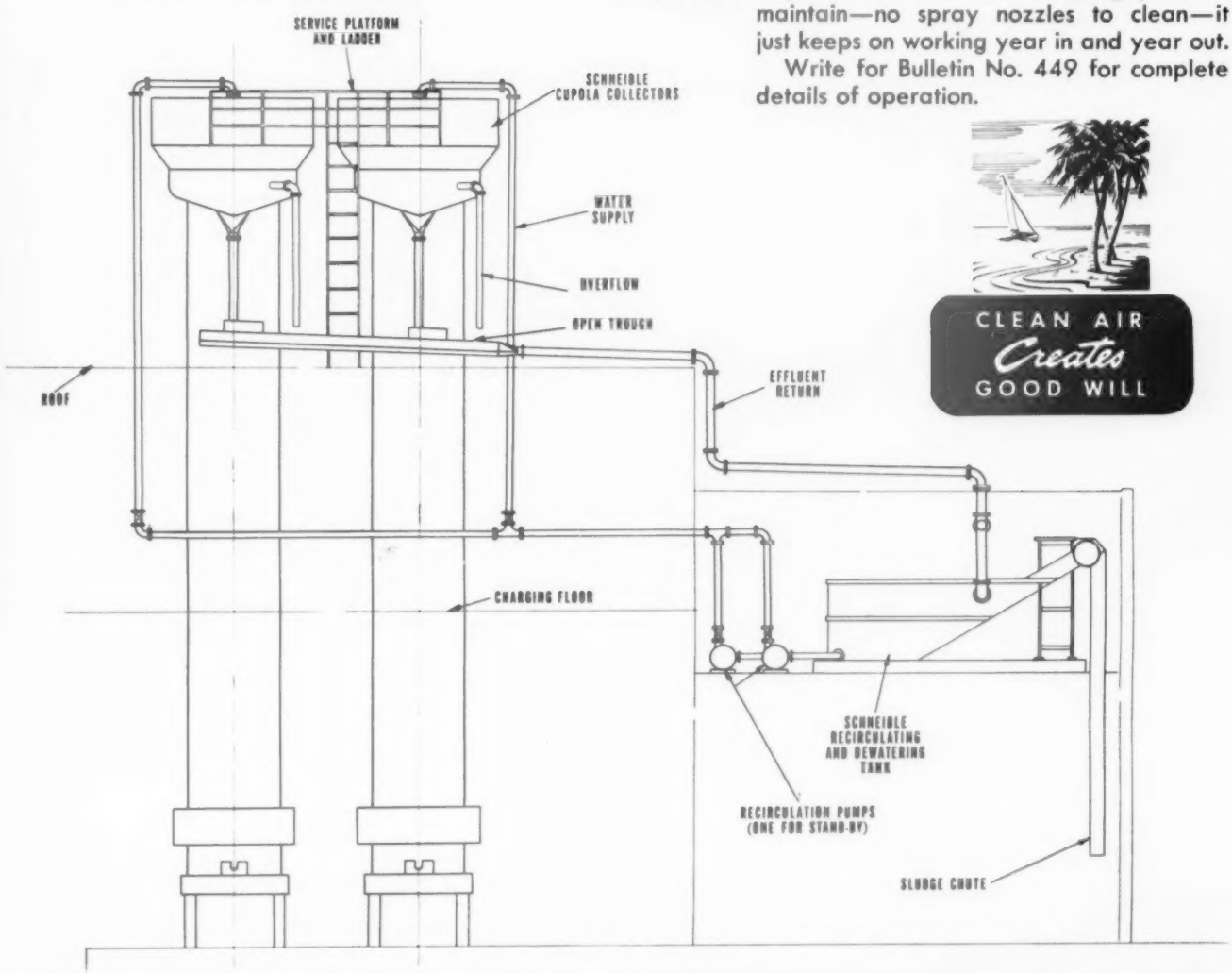
The Schneible Water Curtain type Cupola Collector reduces fly-ash to a minimum—cuts top side maintenance costs and eliminates fire hazard for yourself and neighbors.

Continuous recirculation of water through this collector picks up dust and sparks and returns them to a dewatering tank in the form of harmless, easily disposable sludge.

The Schneible Cupola Collector has no moving parts to maintain—no spray nozzles to clean—it just keeps on working year in and year out.

Write for Bulletin No. 449 for complete details of operation.

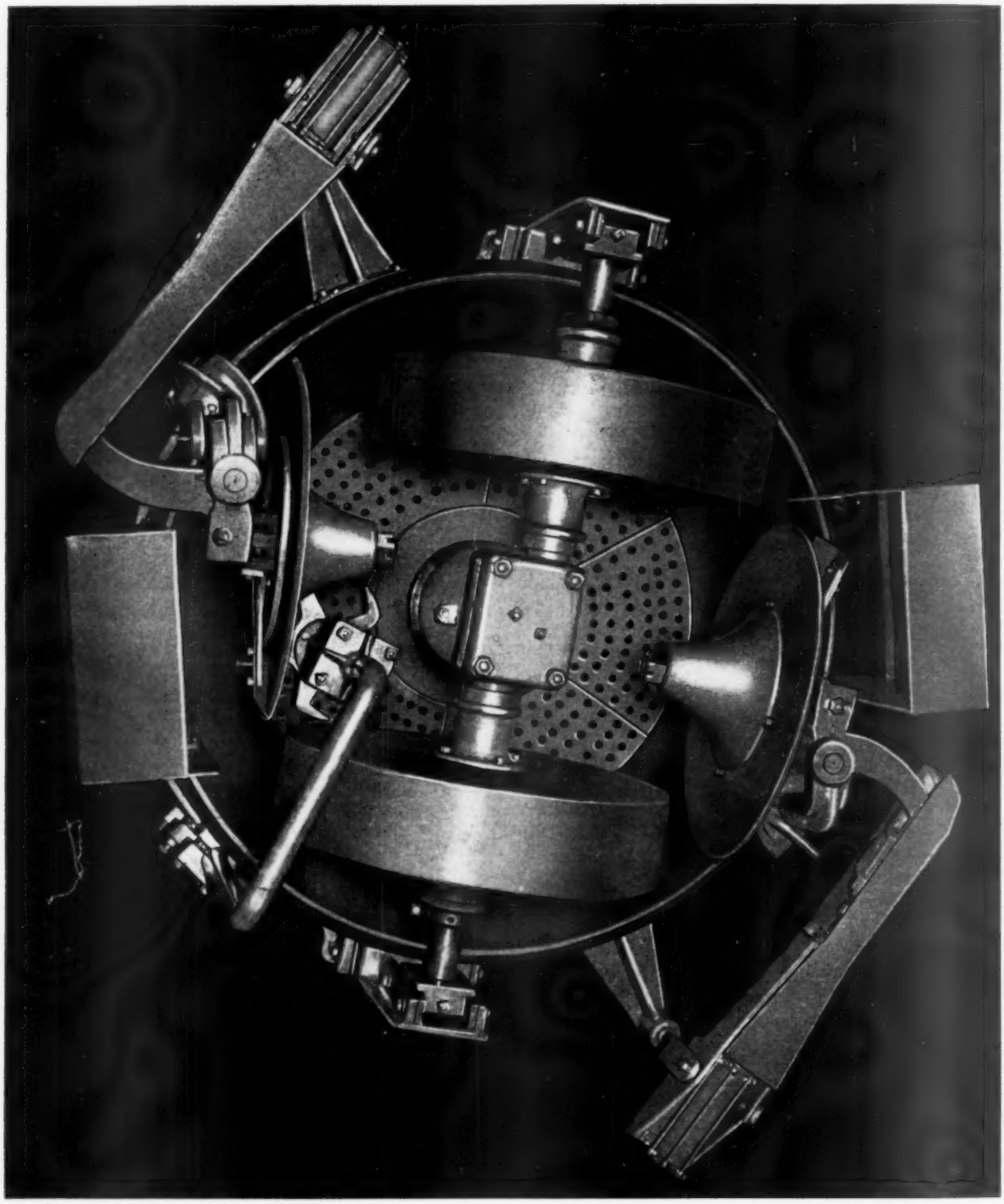
CLEAN AIR *Creates* GOOD WILL



CLAUDE B. SCHNEIBLE CO. • P.O. BOX 502—ROOSEVELT ANNEX • DETROIT 32, MICHIGAN

SCHNEIBLE

FOUNDRY EQUIPMENT MANUFACTURERS ASSOCIATION INC. MEMBER FEMA



Double discharge points on opposite sides of Mixer furnished on special order only. Standard model has one discharge point.

you always get properly prepared sand with a . . .

Clearfield Mixer

Proper preparation of sand for good foundry results is a matter of precision—and can be consistently accomplished only by equipment engineered, designed, and built to encompass all the many factors involved. And that's a perfect description of Clearfield Mixers. There's a Clearfield Mixer to meet any sand preparation need. Write today for catalog No. 79 for complete details.

CLEARFIELD
MACHINE COMPANY

CLEARFIELD
PENNSYLVANIA, U.S.A.

Reduce Your Refractory Costs...

There's a Specific

A. P. GREEN REFRACTORY

for Every Foundry Operation

Scientifically engineered refractories contribute tremendously to operations resulting in fewer rejected castings. The A. P. Green refractory products illustrated will help you accomplish this objective.

The A. P. Green Company manufactures a complete line of fire-clay refractories designed for use in the foundry. Operators throughout the industry have come to depend upon these products to meet their particular requirements. In many cases they have reported 25 to 50 per cent greater service over other materials.

The A. P. Green Fire Brick Company Engineering Department will assist you with further information concerning the reduction of refractory costs in your foundry. Call your local A. P. Green Sales Office or Distributor — listed in the yellow pages of your telephone directory — or write address below.

A. P. GREEN PRODUCTS FOR USE IN THE FOUNDRY
CHECK THIS LIST—SPECIFY THEM BY NAME

SATANITE A super fire-clay mortar — highly resistant to molten metal and slag — eliminates joint erosion.

GREENCOTE Refractory maintenance coating used as a ladle wash coat and for reconditioning refractory linings.

'SAIRSET Air-setting, high temperature bonding mortar for laying fire-brick — has excellent working properties and forms a strong bond.

KAST-O-LITE A lightweight 2500° F. insulating castable recommended for monolithic linings of annealing ovens and heat treating furnaces.

SUPER-PLASTIC A super duty, plastic for lining ladles, cupola spouts and for patching.

CUPOLA BLOCKS Are uniform in shape and size — highly resistant to slagging and abrasive conditions.

INSULATING FIREBRICK

G-20 for temperatures up to 2000° F.
G-23 for temperatures up to 2300° F.
G-26 for temperatures up to 2600° F.

OUR 40TH YEAR SERVING THE WORLD'S INDUSTRIES

A. P. GREEN FIRE BRICK COMPANY
MEXICO, MISSOURI, U. S. A.
In Canada:
A. P. GREEN FIRE BRICK COMPANY, LTD.
Toronto 15, Ontario
Distributors in the Principal Cities of the World

A. P. Green
REFRACTORY PRODUCTS

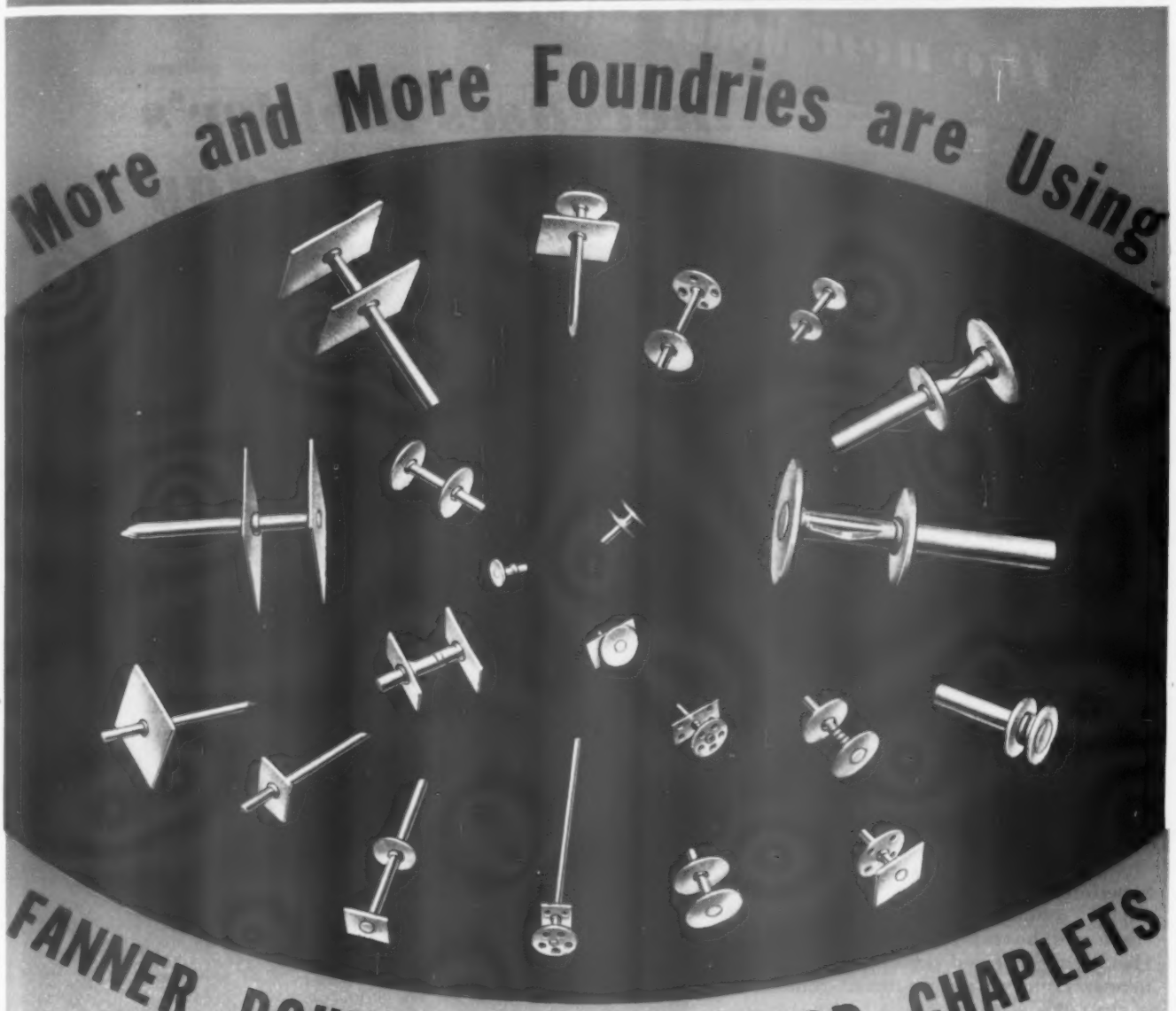
...always low-cost production
...like INTERNATIONAL GRAPHITE ELECTRODES

ICE International GRAPHITE AND ELECTRODE CORP.
ST. MARYS, PA.

6260

IT'S FANNER for CHAPLETS

More and More Foundries are Using



FANNER DOUBLE HEAD ANCHOR CHAPLETS

Important Notice:

Two motion picture films—one on the use of Chaplets, the other on the use of Chills—are available, free of charge, for showing at Foreman Club meetings, in technical schools, A. F. A. chapter meetings, etc. Write for reservation.

These specially Fanner designed chaplets are rapidly replacing other types of chaplets in foundries the country over . . . BECAUSE THEY ARE EXTRA ADDED INSURANCE OF PRECISION CASTING.

The reason is the extended stem which serves as a definite anchor in holding the chaplet in place, keeps it from being washed away in the molten metal.

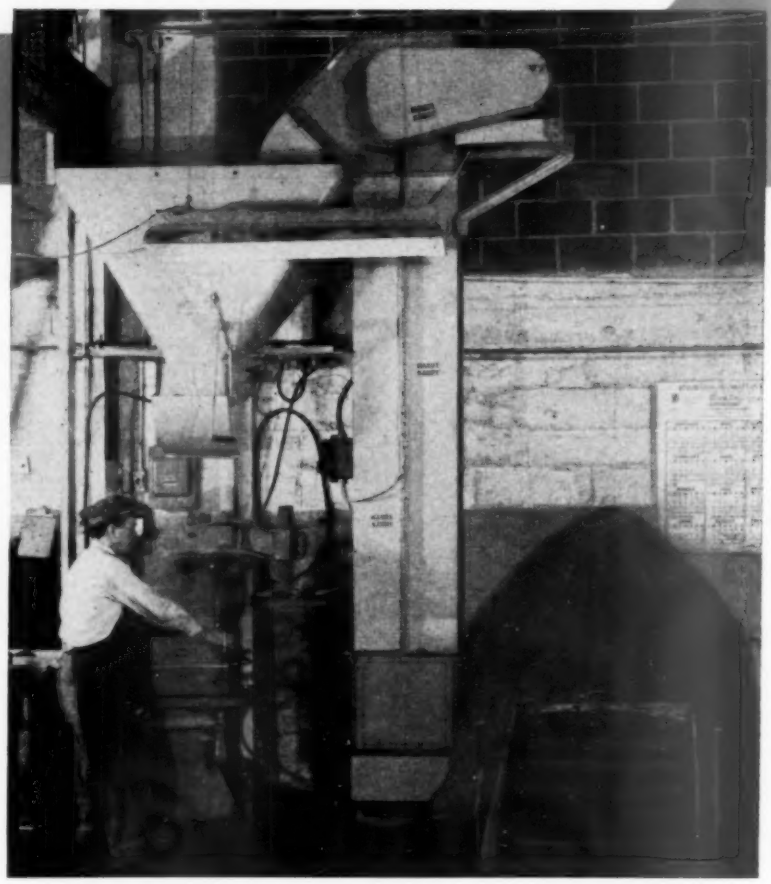
If you're using any kind of chaplets, by all means investigate these Fanner Chaplets without delay.

THE FANNER MFG. CO., CLEVELAND 1, OHIO

In Canada: **CANADIAN FANNER, LTD., Hamilton, Ont. Canada**

the new HANDY SANDY increases molder's output 50 molds per day

at the MICHIGAN WHEEL COMPANY
Grand Rapids, Michigan



Test proves Cost Reducing Advantages of HANDY SANDY

When a molder is shoveling, he is not producing. Replace his shovel with a Handy Sandy and he will turn out more molds for you at less cost per mold. This was the result when the Michigan Wheel Company tried a Handy Sandy in casting 4 pound propellers from Manganese Bronze. When filling the flasks by hand, one molder produced from 50 to 55 molds per day. NOW, with a Handy Sandy supplying the sand, the same man turns out from 90 to 100 molds daily — and still "feels like working another shift."

According to Mr. W. R. Royce, Foundry Superintendent, the sand is more thoroughly conditioned and all lumps are eliminated by the extra aeration of the Handy Sandy. Hand riddling is no longer necessary due to the improved condition of the sand. Castings have a better appearance, there are fewer rejects and all excessive grinding and finishing have been eliminated.

"What's more," says Mr. Royce, "The Handy Sandy takes no more space than the sand heap. It's ideal where space is at a premium. We are going to equip the Foundry throughout."

GIVE YOUR MOLDERS A LIFT WITH A HANDY SANDY AND WATCH YOUR PROFITS GROW.

Write for full details today.

NEWAYGO ENGINEERING COMPANY

NEWAYGO, MICHIGAN

Manufacturers of NeWay Mold Handling, Sand Handling and Conditioning Equipment

Refractory Cement Selection Made Easy

for ferrous melting furnaces

Type of furnace	metals melted	use of cement	Norton number	cement recommended description	maturing temp.	max. temp.	how applied
indirect arc	alloy iron and malleable iron	lining	RA1144	coarse grain Alundum* cement	2100°F	2950°F	rammed
		patching	RA1160		1850°F		rammed
		troweling around electrodes	RA162	fine grain Alundum cement	1850°F	2950°F	troweled
direct arc	alloy steel and malleable iron	lining roof and around electrodes	RA1144	coarse grain Alundum cement	2100°F	2950°F	rammed
		lining roof and around electrodes	RA1195	very coarse grain Alundum cement	2000°F	3100°F	rammed
		patching	RA1160		1850°F		rammed
high frequency induction	stainless steel and refractory alloys	lining	RM1169	very coarse grain Magnorite* cement	2100°F	3250°F	rammed (dry)
		patching large furnaces	RM868	medium grain Magnorite cement	2200F°	2750°F	rammed
		patching small furnaces	RM1171	medium grain Magnorite cement	2000°F	2900°F	troweled or rammed

for non-ferrous metal-melting furnaces

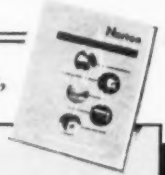
low frequency induction	refractory alloys, cupronickel, nickel silver, high copper alloys Al, Te, Si bronzes	lining	RM1140	coarse grain Magnorite cement	2300°F	3250°F	rammed
	nickel silver	lining	RA1195	very coarse grain Alundum cement	2000°F.	3100°F	rammed
	brasses not more than 90% copper or less than 10% zinc	lining	RA1144	coarse grain Alundum cement	2100°F	2950°F	rammed
indirect arc	...ickel and high nickel alloys	lining	RA1144	coarse grain Alundum cement	2100°F	2950°F	rammed
		patching	RA1160		1850°F		
crucible melting furnaces■	brasses and bronzes	lining and patching	RC1188	coarse grain Crystolon* cement	2000°F	3050°F	rammed
		lining and patching	RC1133	coarse grain Crystolon cement	2100°F	2950°F	rammed
		lining and patching	RC1204	coarse grain Crystolon cement	2000°F	2900°F	rammed
reverberatory furnaces▼	brasses and bronzes	lining and patching	RC1188	coarse grain Crystolon cement	2000°F	3050°F	rammed
		lining and patching	RC1133	coarse grain Crystolon cement	2100°F	2950°F	rammed
		lining and patching	RC1204	coarse grain Crystolon cement	2000°F	2900°F	rammed

■ Cement not in contact with metal, used in combustion chamber.
▼ Cement in contact with metal. * Trade-marks Reg. U. S. Pat. Off. and Foreign Countries.

This Chart is a synthesis of several charts from a new 16-page bulletin just prepared by Norton refractory engineers, after exhaustive laboratory and field tests.

Titled "Norton Longer Lasting Refractory Cements," this fact-packed bulletin covers the properties, selection and application of the correct cement for your refractory requirements.

Write for Bulletin 863. Norton Company, 300 New Bond Street, Worcester 6, Mass.



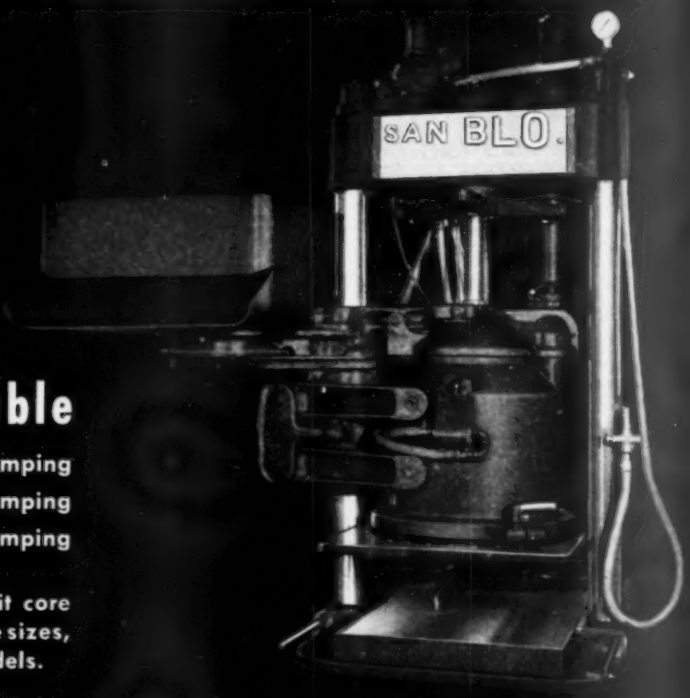
NORTON

Making better products to make other products better

Special REFRACTORIES

Gone are the limitations you've been accustomed to...on core blowing...

"SAN-BLO" *now provides versatility and efficiency never before attainable*



Bench Model CB-40
with Universal Vent Plate

3 Models Available

CB-40. . . . Bench Model, automatic clamping
CB-40F. . . . Floor model, automatic clamping
CB-40FD. . . Floor model, automatic clamping and 6" automatic draw

Horizontal clamps for split core boxes are available in three sizes, as accessories, for all models.

HERE'S WHAT YOU CAN DO WITH "SAN-BLO"

• blow all types of core sand

Now for the first time—a sand blower with which you can successfully blow any type sand—dry core compound, oil sand or facing sand for green topping of cores.

• blow sand of high green strength

For the first time—a sand blower with which you can blow sand of any green strength up to 8 lbs. You can mix the proper sand without worrying about green strength.

• blow sand of high moisture content

And for the first time—a sand blower with which you can blow sand of any moisture content up to 8%. Moisture content is never critical when you use the new SAN-BLO.

• blow large and small cores

You can produce an unusually wide range of core sizes—single cores weighing up to 40 lbs. each, or 40 lbs. of small cores, without refilling or moving blow head.

• blow all types of core boxes

You can use your present equipment with SAN-BLO, for it blows any type core box—open or closed, wood or metal boxes. You won't have to purchase new or special boxes.

• blow open and closed boxes *thru one blow hole*

You can save time with SAN-BLO, because all open and closed boxes are blown through one ¾" diameter hole in the universal blow plate. Blow plate changes are unnecessary.

GOOD NEWS FOR *Jobbing Foundries*

Here, finally, is a sand blower designed also to meet jobbing foundry conditions. SAN-BLO is ideal for short runs because there are no costly delays in changing boxes. Only one quick adjustment. Universal blow and vent plates. Blows any type sand—any type box—large and small cores. Close sand control is unnecessary. SAN-BLO is truly an all-purpose sand blower you can use in your foundry all day—every day.

For further information, call your local FEDERAL representative or write direct to . . .

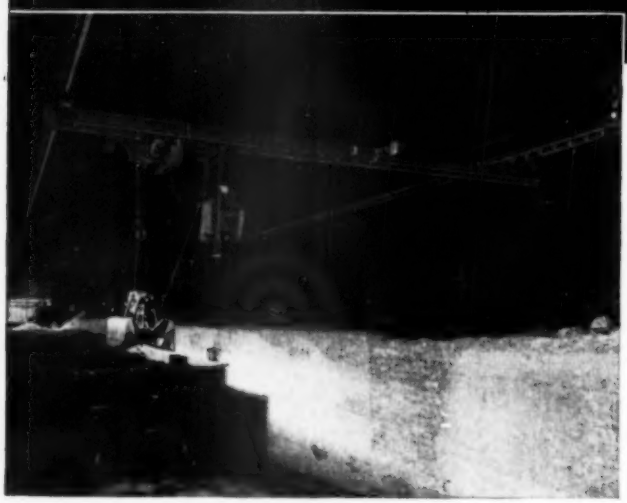
THE FEDERAL FOUNDRY SUPPLY COMPANY

4600 East 71st Street • Cleveland 5, Ohio

CHICAGO LOS ANGELES DETROIT MILWAUKEE RICHMOND, VA. ST. LOUIS
CHATTANOOGA MINNEAPOLIS NEW YORK CROWN HILL, W. VA. UPTON, WYO.

CLEVELAND TRAMRAIL BUCKET CRANES

SPEED FOUNDRY SAND HANDLING • •



The cranes are 44'-0" long and operate on two-track runways. They are controlled from either platform or floor by pendant push-button stations.

This crane has been operating successfully for 4 years, 24 hours a day. The single line grab bucket requires no motor and is of a type that eliminates most of the usual impact on crane. The bucket is easily detached when it is desired to handle loads with the crane hook.

AN AVERAGE of nine 60 ton gondola cars of sand are handled every 24 hour working day with two Cleveland Tramrail Platform-controlled motorized cranes with ½ yard buckets in a large Illinois foundry.

Some of the sand is taken to storage and later transferred to bins. Other sand is taken to storage, then to drier and finally to bins, thus is handled three times with the cranes. As the sand is handled one to three times, it is evident that somewhere between 1000 and 1500 tons are handled every day.

The cranes, which are operated by both men and women, have served in this rigorous work for several years with need of only minimum maintenance.

GET THIS BOOK!

BOOKLET No. 2008. Packed with valuable information. Profusely illustrated. Write for free copy

CLEVELAND TRAMRAIL DIVISION
THE CLEVELAND CRANE & ENGINEERING CO.
3807 East 286th St. Wickliffe, Ohio

CLEVELAND TRAMRAIL
OVERHEAD MATERIALS HANDLING EQUIPMENT

Advertisement

ELECTROMET Data Sheet

A Digest of the Production, Properties, and Uses of Steels and Other Metals

Published by Electro Metallurgical Division, Union Carbide and Carbon Corporation, 30 East 42nd Street, New York 17, N. Y. • In Canada: Electro Metallurgical Company of Canada, Limited, Welland, Ontario

VANADIUM...the metal that accentuates the effects of other alloying elements

Vanadium is usually added to steel or iron along with other alloying metals, such as manganese, tungsten, nickel, or chromium. It enhances the effect of these other alloys and helps to improve the physical properties of the metal. Generally it is used in quantities of less than 0.50 per cent, but even in these small amounts it is responsible for many marked improvements in the quality of iron and steel.

One of the most notable functions of vanadium is its effect in improving the dynamic properties of steel, such as fatigue and impact resistance. It also gives an inherently fine grain size to both steel and iron.

In high-speed tools, vanadium contributes wear resistance and red hardness. It is also an important alloy in many types of permanent magnet steels. These and many other types of special-purpose steels contain more than 0.50 per cent vanadium to enhance certain properties.

Dynamic Strength for Steels

The principal effect of vanadium in engineering steels is that of refining grain size. It is usually added in amounts of 0.10 to 0.25 per cent.

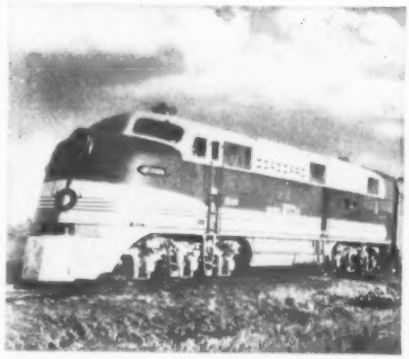


Fig. 1. Steels in which vanadium is an alloy have outstanding dynamic strength. That is why they are frequently used in such heavy-duty service as springs and axles in diesel locomotive trucks.

In the lower carbon ranges, vanadium steels are especially suited for carburizing and are used for such applications as hand tools, bearings, and pistons. Vanadium-bearing steels can also be nitrided effectively.

Vanadium contributes fatigue and impact resistance and also strength and ductility to spring steels. The famous chromium-vanadium (SAE 6100 series) and manganese-vanadium spring steels are outstanding examples of this use. Besides being used as springs, these steels are frequently used for axles, shafts, and other highly stressed moving engine parts.

Red Hardness in Tools

Practically all fine tool steels contain vanadium. In high-speed steels, vanadium content usually ranges from about 0.50 to 2.50 per cent, although higher percentages are sometimes used. Other alloy tool steels usually contain from 0.20 to 1.00 per cent vanadium.

Vanadium is a strong carbide-former and forms very hard and stable carbides. These vanadium-carbides are probably the main reason for the excellent wear resistance and edge-holding properties of vanadium tool steels. The persistence of the vanadium-carbides is largely responsible for the cutting qualities at red hardness of high-speed tool steels.

Adds Strength to Cast Iron

In amounts of 0.10 to 0.15 per cent, vanadium increases the strength of cast iron from 10 to 25 per cent, and adds a considerable amount of toughness. Cast iron containing vanadium is especially valuable in such applications as steam locomotive cylinders, valve and piston bushings, piston rings, and similar parts. In steam engines and diesel motors, vanadium cast iron cylinders greatly outlast those of ordinary cast iron. Chromium-vanadium cast iron rolls, containing up to 2 per cent chromium, have been used successfully in steel mills for a great many years.

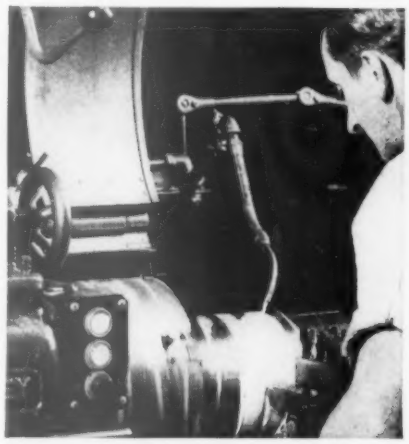


Fig. 2. Nearly all fine tool steels contain vanadium. It promotes fine grain size, high wear resistance, and greater control of hardenability. Vanadium also contributes to the red hardness of high-speed tool steels.

Cast iron in which vanadium is the sole alloying element is used primarily in applications where temperatures are moderately high and in heavy sections requiring uniform hardness without brittleness.

ELECTROMET Vanadium Alloys

ELECTROMET produces three grades of ferrovanadium in various sizes for the production of vanadium-bearing steels and irons. Each grade has a definite range of carbon and silicon contents and is especially adapted to assure the best results in the different requirements of iron and steelmaking.

Write for a copy of the booklet, "ELECTROMET Ferro-Alloys and Metals." It contains many useful facts about the use of ferrovanadium. The booklet also describes over 50 other alloys and alloying metals produced by ELECTROMET.

The term "Electromet" is a registered trademark of Union Carbide and Carbon Corporation.

To Increase your Production . . .
To Lower your Grinding Costs . . .
Specify NORTON WHEELS—

Each specially designed for a definite grinding job

Wheels for Nonferrous Foundries—You get fast, clean cut and extra long life which add up to lower grinding costs when you select Norton wheels of strong, sharp 37 CRYSTOLON abrasive and special B-5 or B-7 resinoid bond for use on your high speed grinders. You get these same cost-cutting features when you select CRYSTOLON wheels with vitrified bond for your slow speed grinders too — and don't forget that Norton wheels are available with special treatments which prevent loading and glazing.

Wheels for Ferrous Foundries — Many foundries grinding steel or annealed malleable iron castings have discovered that Norton wheels of tough, sharp ALUNDUM or 57 ALUNDUM abrasive with B-5 or B-7 resinoid bond increase their production and cut their grinding costs. And many others, grinding gray iron castings, depend on Norton wheels of strong, sharp CRYSTOLON abrasive with B-5 or B-7 resinoid bond to keep their grinding costs down. Are you using these fast-cutting, long-lasting wheels?

Making better products to make other products better

Are you using this cost-cutting new wheel?

NORTON *Reinforced* Hub Wheels — Now you can remove gates and risers from large castings quickly, safely and economically, by notching them with the new *Reinforced* Hub Wheel and then knocking them off with a sledge. Many foundries are also using the new wheels for removing mold marks and for smoothing up castings. These strong, reinforced wheels may be used on your right-angle or straight-shaft portable grinders without danger of wheel breakage.

Cut-off Wheels — Strong, safe NORFLEX Reinforced Resinoid wheels have replaced conventional resinoid or rubber bonded cut-off wheels on many jobs where wheel breakage has been high. These wheels — mounted on Tabor-type cut-off machines — will remove sprues, gates and risers from small nonferrous castings quickly and easily. Other types of resinoid and rubber bonded wheels are available for cutting higher tensile strength metals and non-metallic materials.

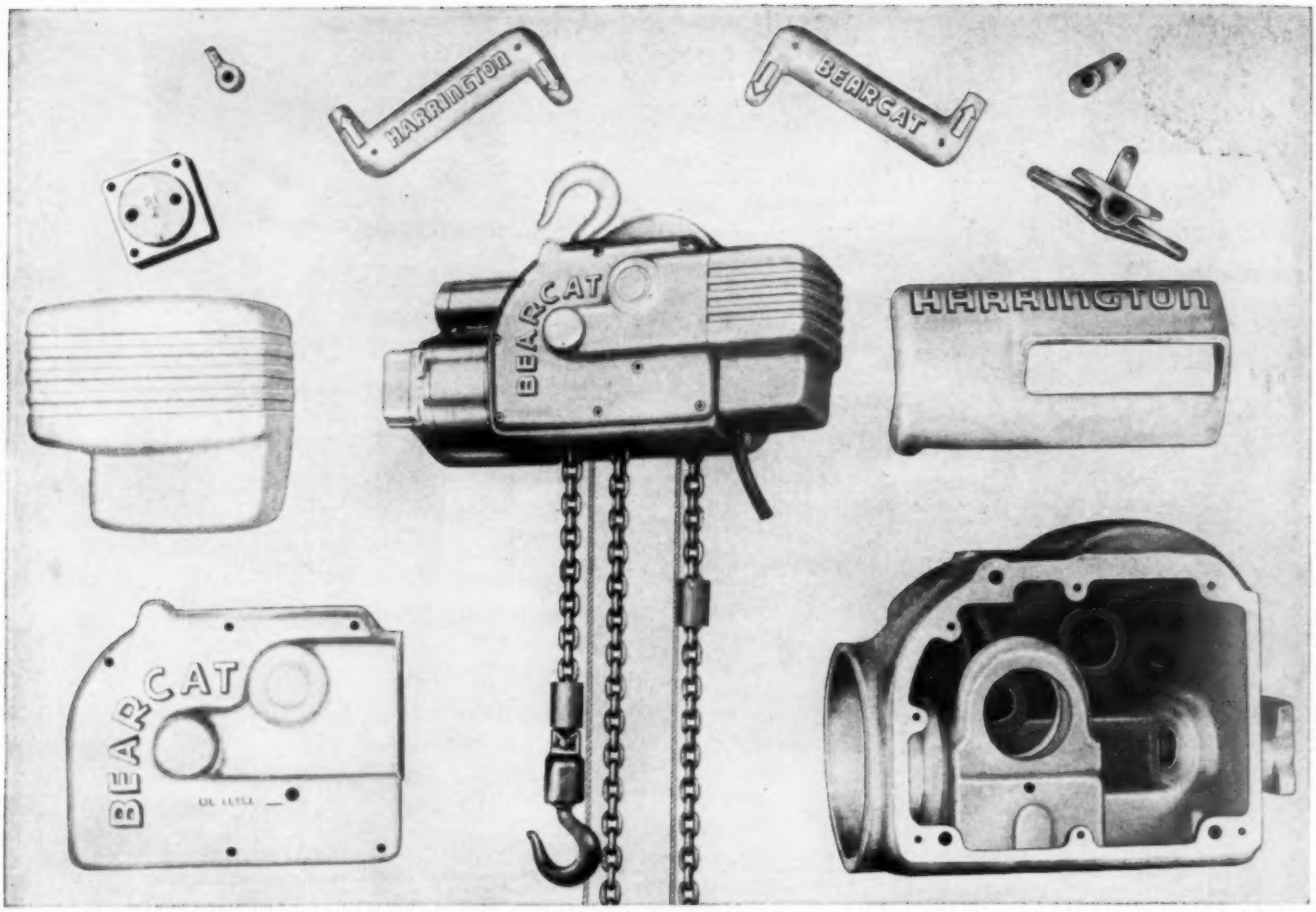
Discs — Foundries everywhere are reducing surfacing costs on aluminum brass and gray iron castings with Crystolon discs with special B-5 resinoid bond. And they're reducing costs on steel and annealed malleable iron castings with Norton discs of fast-cutting 57 ALUNDUM abrasive and B-5 resinoid bond. You'll find these discs available in exactly the right sizes and with all types of mountings commonly used, including inserted nut and plate mounted.

Mounted Wheels and Mounted Points — You can remove excess metal from hard-to-get-at places quickly and easily with Norton Mounted Wheels and Mounted Points. They're available with fast-cutting 38 ALUNDUM abrasive for jobs on steel and steel alloys — with 37 CRYSTOLON abrasive for jobs on cast iron, chilled iron and nonferrous metals, and in over 200 standard sizes and shapes.

Test these cost-cutting Norton products on your grinding jobs. Contact your Norton abrasive engineer or distributor for full details.

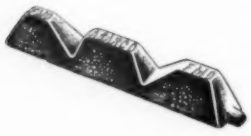
NORTON ABRASIVES

NORTON COMPANY, WORCESTER 6, MASS. • Warehouses in Five Cities • Distributors in all Principal Cities



JMLco.F

Cut Weight, Eliminate Heat Treatment, Improve Properties — with TENZALOY



Casting ten parts of the Bearcat electric hoist (above) in TENZALOY enabled the manufacturer, The Harrington Company, Philadelphia, to:

1. Produce the article without heat treatment, thus saving an added expense.
2. Reduce castings' weight from an average of about 60 lbs. (original ferrous metal design) to 20 lbs., thus improving portability.
3. Cut machining and handling costs.
4. Improve appearance and corrosion properties, thus increasing sales appeal.
5. Virtually eliminate rejects.

The Fisher Casting Company, North Plainfield, N.J., which cast the components shown above, is a longtime user of TENZALOY. Its competent staff knows well this aluminum-magnesium-zinc alloy which Federated developed to give high strength without heat treatment. Therefore, when they recommended TENZALOY, and worked with Harrington and Federated engineers on the project, they were certain of its eventual success.

This happy and profitable experience can be yours, too. Write Federated's Dept. CW for technical pamphlet on TENZALOY.

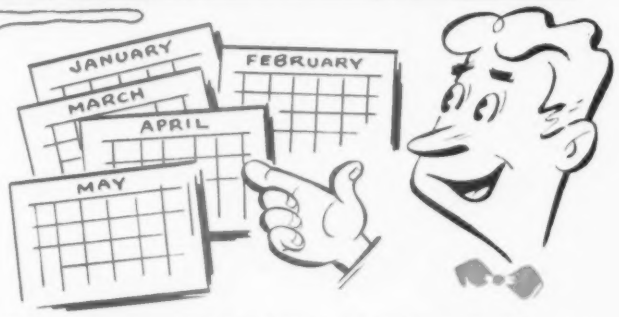
Federated first in the non ferrous field AMD

Federated METALS DIVISION

AMERICAN SMELTING AND REFINING COMPANY, 120 BROADWAY, NEW YORK 5, N.Y.

Lynchburg Foundry* SAVES 56.7% on BLAST CLEANING with Malleabrasive!

* *Results of Malleabrasive test conducted by Lynchburg Foundry Co. of Lynchburg, Va., as reported by The Globe Steel Abrasive Co.*



To get the facts on Malleabrasive, Lynchburg Foundry set aside 16 weeks for comparative tests to check cleaning costs before and after using Malleabrasive.

The results were amazing! Lynchburg's impartial tests proved 100 lbs. of Malleabrasive does the work of 230 lbs. of ordinary shot or grit . . . an actual saving of 56.7% hourly!

Further checks on cleaning costs showed Malleabrasive saved $7.38 out of every $10.00 Lynchburg formerly spent for replacement parts. But that's not all . . .

After all test results were in, Lynchburg Foundry found the switch to Malleabrasive means an actual cash saving of $2,995.00 a year—all clear profit.

TEST MALLEABRASIVE YOURSELF!

If you want to save money on blast cleaning, take advantage of this offer! We'll send you all data needed to run a comparative test *just like Lynchburg's* right in your own cleaning room! Remember, Malleabrasive is ***guaranteed*** to outperform ordinary shot and grit when comparative tests are properly run. Malleabrasive is more than "heat treated" or "annealed," Malleabrasive is a radically new abrasive. But find out for yourself. Write for TEST INFORMATION to: THE GLOBE STEEL ABRASIVE CO., Mansfield, Ohio.

†U.S. Patent #2184926
(other patents pending)

Save on blast cleaning with

PATENTED† Malleabrasive®

THE GLOBE STEEL ABRASIVE CO., MANSFIELD, OHIO

· MANUFACTURERS OF METAL ABRASIVES SINCE 1907 ·

ANOTHER DIE CAST PRODUCT MADE BETTER ON KUX DIE CASTING EQUIPMENT

YALE

AND TOWNE MANUFACTURING COMPANY

makes better locks

WITH

KUX

DIE CASTING MACHINES

AFTER A TWO-YEAR survey of all leading machine manufacturers, The Yale & Towne Manufacturing Company selected KUX as the line of Die Casting Machines superior to any in the country.

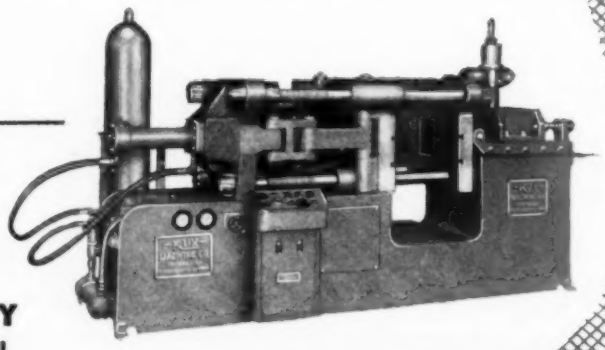
Now, production lines of powerful KUX Die Casting Machines, installed in Yale plants, produce their various hardware castings on a 'round-the-clock basis.

Possibly your product can be redesigned to use die castings with substantial savings in manufacturing costs. Let KUX engineers give you the answer.

MODEL BH-30 ILLUSTRATED

Hydraulically operated die casting machine for production of zinc castings weighing up to 10 pounds.

Write for illustrated catalog showing complete line of KUX Die Casting Machines.



KUX MACHINE COMPANY
3932 W. HARRISON STREET • CHICAGO 24, ILL.

Brief Notes for Busy Foundrymen

What do they Do . . ?

Volclay (a Western bentonite) is added to foundry sands to furnish green dry, and hot strengths. Only 5% by weight addition is required with 95% unbonded sand to furnish correct molding properties. **Volclay** gives excellent dry and hot strengths, which overcome cuts, washes, and other defects common to weak sands subjected to heat.

Panther Creek (a Southern bentonite) requires about the same addition as when Volclay is used, yet the dry and hot strengths are *much lower*. There is a moving trend toward the use of Panther Creek as a bond, since it enables *greater production* through its increased flowability and easy ramming characteristics. **Panther Creek** helps to overcome cracks, hot tears, and other defects common to high hot strength.

Five Star Wood Flour is rapidly taking its place as a foundry material. More foundrymen are finding that a 1/4%-2% addition by weight offers better sand mixtures. It furnishes better casting peel, less sand loss from over-baking, a reducing atmosphere and improves ramming and *overcomes sand expansion*, thus relieving scab, buckle, and rat-tail defects. Its presence insures satisfactory deformations, removing the constant fear of *too hard ramming* in sections of the mold. Density affects sand expansion and sand contraction, and **Five Star Wood Flour** controls density to the discretion of the technician.

KNOW your products and less Molding and Casting Difficulties will arise!

Our New Address: Merchandise Mart Plaza—Chicago 54, Illinois

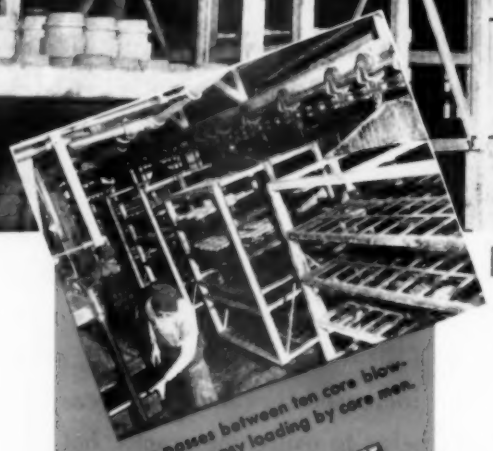
VOLCLAY Western Bentonite • FIVE STAR Wood Flour • PANTHER CREEK Southern Bentonite

AMERICAN COLLOID COMPANY Chicago Illinois • Producers Since 1927

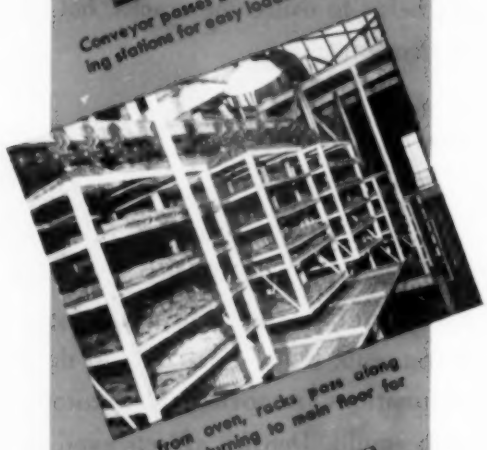
Available from Leading Foundry Suppliers in the United States and Canada

This Core Room Has EVERYTHING

TO INCREASE PRODUCTION & QUALITY; LOWER CORE MAKING COSTS!



Conveyor passes between ten core blowing stations for easy loading by core men.



Emerging from oven, racks pass along cooling zone returning to main floor for unloading.

With cores sufficiently cooled, unloading begins as soon as racks reach main floor.

DESPATCH OVERHEAD CORE OVEN

Makes Every Square Foot of Floor Space Available to Core Handling!

A little over a year ago the J. I. Case Co. of Rock Island, Ill. built a 110′ x 60′ addition to their foundry to house a modern conveyorized core room. DESPATCH Engineers collaborating with Case Foundrymen, designed, built and installed a core room system that, in the words of Stanley Olson, Foundry superintendent, "has effected savings of over 25% in core handling; has reduced core breakage and rejects by more than 25%; has raised core quality 50% and has brought about 100% better working conditions."

DESPATCH features include a 3-pass, convection heated oven of overhead construction, making available every square foot of floor space underneath for core handling. Overhead oven also provides a bottom entrance for the 392-ft. continuous conveyor, providing a natural heat seal. Direct gas fired air heater supplies the heat and hi-volume fans provide rapid heat transfer. After leaving the oven, cores pass through an open cooling zone and are returned to floor level for unloading. The effective oven ventilation system eliminates core gas in the core room.

The Case Foundry uses 50 tons of sand per 8-hour day and produces miscellaneous tractor and implement cores. Sand is supplied to the ten core blowing stations by a unique overhead supply system, eliminating the shovel and wheelbarrow method.

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DESPATCH Core Ovens are specially designed to increase production through better baking efficiency. With direct gas or oil fired heaters and special Despatch convection heating, fuel costs are drastically cut. Trouble-free operation cuts maintenance to a minimum. Equipped with automatic temperature controls and fire underwriters' approved safety system, you can depend on DESPATCH ovens for safe, unexcelled performance.

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It's unique for two reasons—it was cast with cement-bonded sand . . . and that sand will be removed in ten minutes!

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Flasks like this are routine for the Floatex Shakeout, and there's good reason why . . . it's *designed* right and it's *built* right. Floatex is big, it's fast, yet it's gentle. It does the job by shaking the *flask*—not the foundry.

The live frame is supported by soft, heavy duty coil springs. Vibration can't escape to weaken building structures, collapse unpoured molds or jangle workers' nerves. And every inch of the Floatex deck vibrates . . . *every inch is alive.*

What's more, Floatex can do not *one* but *two* basic foundry jobs . . . flask shakeout and core knockout . . . in a single operation without removing the casting! That means only *one* investment, and twice the work from the same machine.

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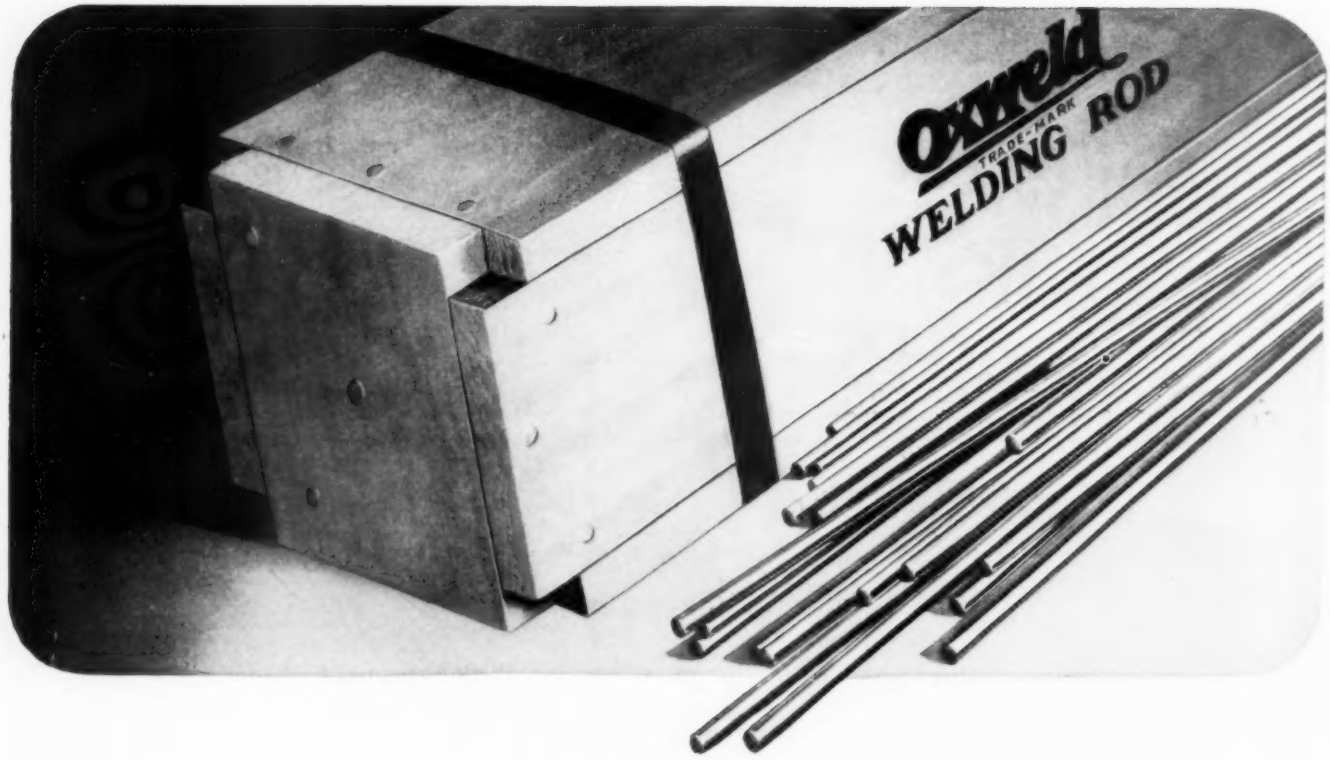

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✓ **You use less rod per weld,** because OXWELD Rods produce high-strength welds with minimum reinforcement. OXWELD No. 1 H. T. Rod, for example, has a tensile strength 11,000 lb. per sq. in. higher than any ordinary steel rod—enough *extra strength* to permit reduction of the amount of weld metal on a job, with substantial saving of gases and labor.

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MILWAUKEE jolt-squeeze-rollover-draw machines incorporate conveniently located control valves, rigid frames and tie pieces to assure parallel squeeze, cast steel cradle, and a roller conveyor frame that rests on four hydraulic pistons. Jolt mechanism, squeeze cylinder, and leveling device are integral parts of heavy machine base. Flask clamp assemblies are mounted on cradle-ways to facilitate rapid, accurate adjustment, and two aligned rods guide cradle during jolting, squeezing, and pattern draw operations.

With production ***speed*** and ***savings*** the keynotes of today's highly competitive markets, MILWAUKEE molding machines are the most modern equipment available for the production of heavy drag molds of uniform standard. *When you buy, specify MILWAUKEE equipment* . . . and you will have **PRODUCTION PROFITS IN YOUR HANDS! Write for Bulletin No. 115**

Milwaukee-Taccone Model 3-A Core Blower is described in detail in Bulletin 119-A. Operational features of this fully automatic, explosion-type core blower are illustrated by photos and specification charts.

Bulletin 113 contains specification and drawings on 9 types of plain jolt machines, which have capacities ranging up to 10,000 pounds. Dimensions and shipping weights also are listed.

Four models of car-type jolt-squeeze-strip cope making machines are presented in Bulletin 121. Over-all specifications and dimensions, as well as detailed drawing of overhead carriage, are included.

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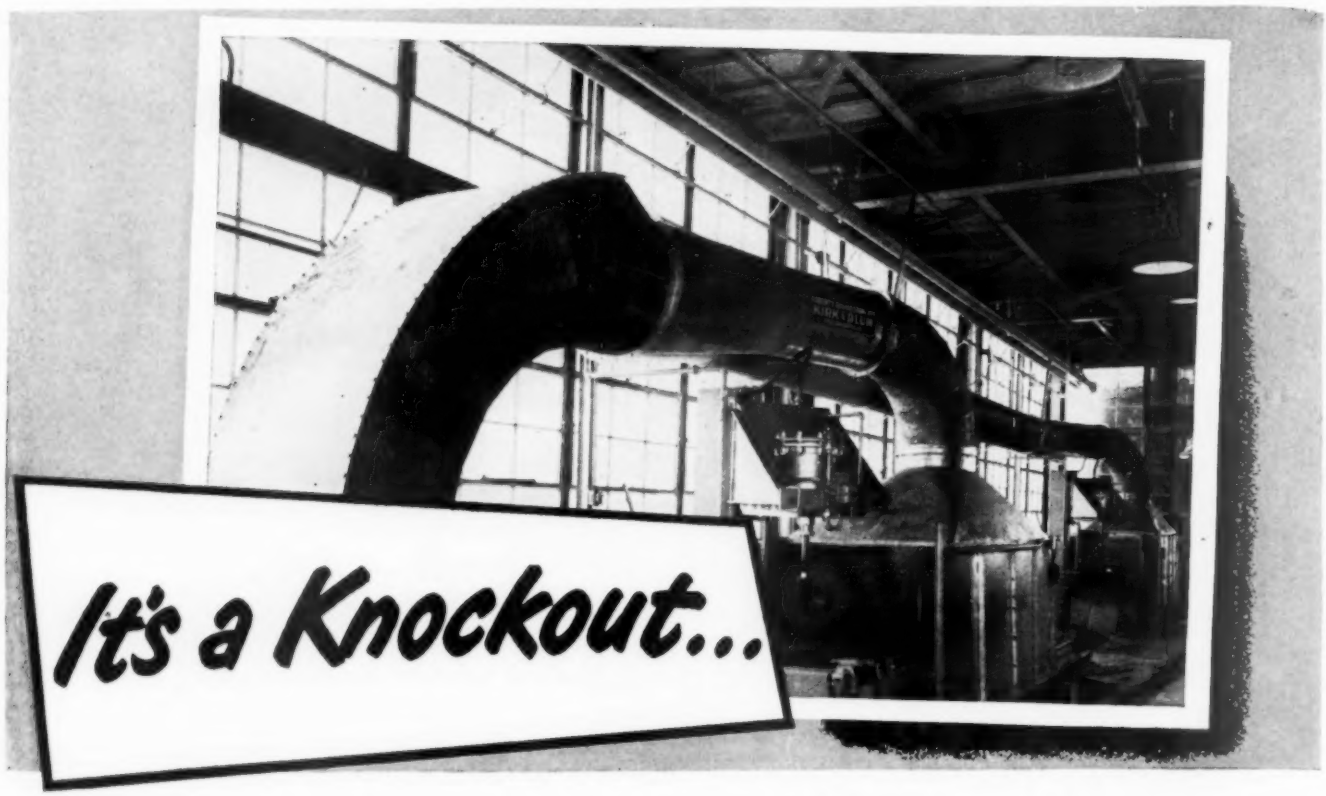

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In the photo shown above, for example, a dust control system fabricated and installed by Liberty Engineering, Division of KIRK & BLUM virtually eliminates dust. Of particular interest is the "flat-back" elbow. The curved plate shown is easily replaced or may be lined with abrasion-resistant material to meet severe conditions.

The photograph below shows the molding line, hoppers and supports which were also fabricated and installed by the Liberty Engineering Division. Other KIRK & BLUM systems are found in this same well known manufacturer's plant.

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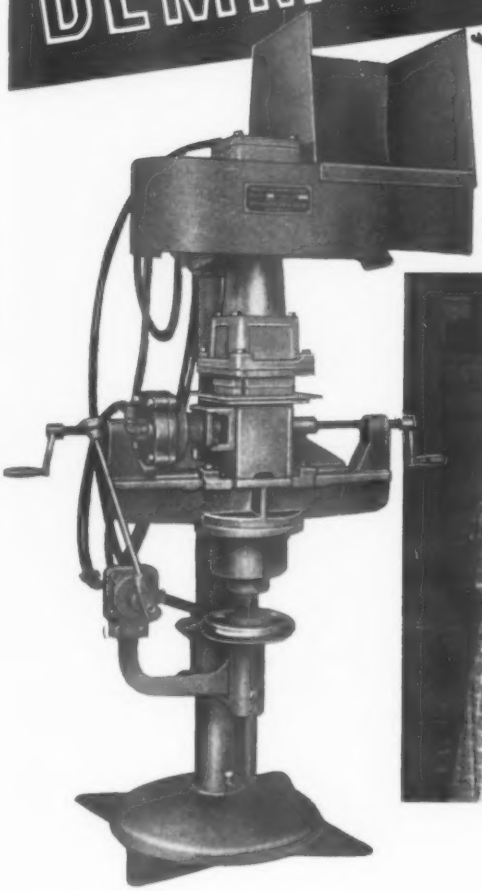
CUT CORE BLOWING COSTS 30%

FOR PEORIA MALLEABLE CASTINGS CO.



Anna Gerhards and Dewey Rakestraw of Peoria Malleable Castings Co. are seen at their DEMMLER NO. 55's. Being blown are chain cores and ball type trailer hitch cores.

Here, indeed, is a real success story — one that every foundry can share.

It concerns Peoria Malleable Castings Co. of Peoria, Illinois, who, through the purchase of six DEMMLER NO. 55 Core Blowers, reduced their small core blowing costs by 30%!

Peoria Malleable Castings had previously used other makes of small core blowers, but now DEMMLER NO. 55's carry the load — efficiently and profitably.

Quality of cores produced by the DEMMLER machines, reports Peoria Malleable Castings Co., is excellent, being extremely uniform and far superior to that of hand made cores.

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Features

- **Ideal for short run jobs**
- **Quick, easy adjustments for raising table and moving chuck jaws**
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Write for Illustrated DEMMLER NO. 55 specification sheet — today!

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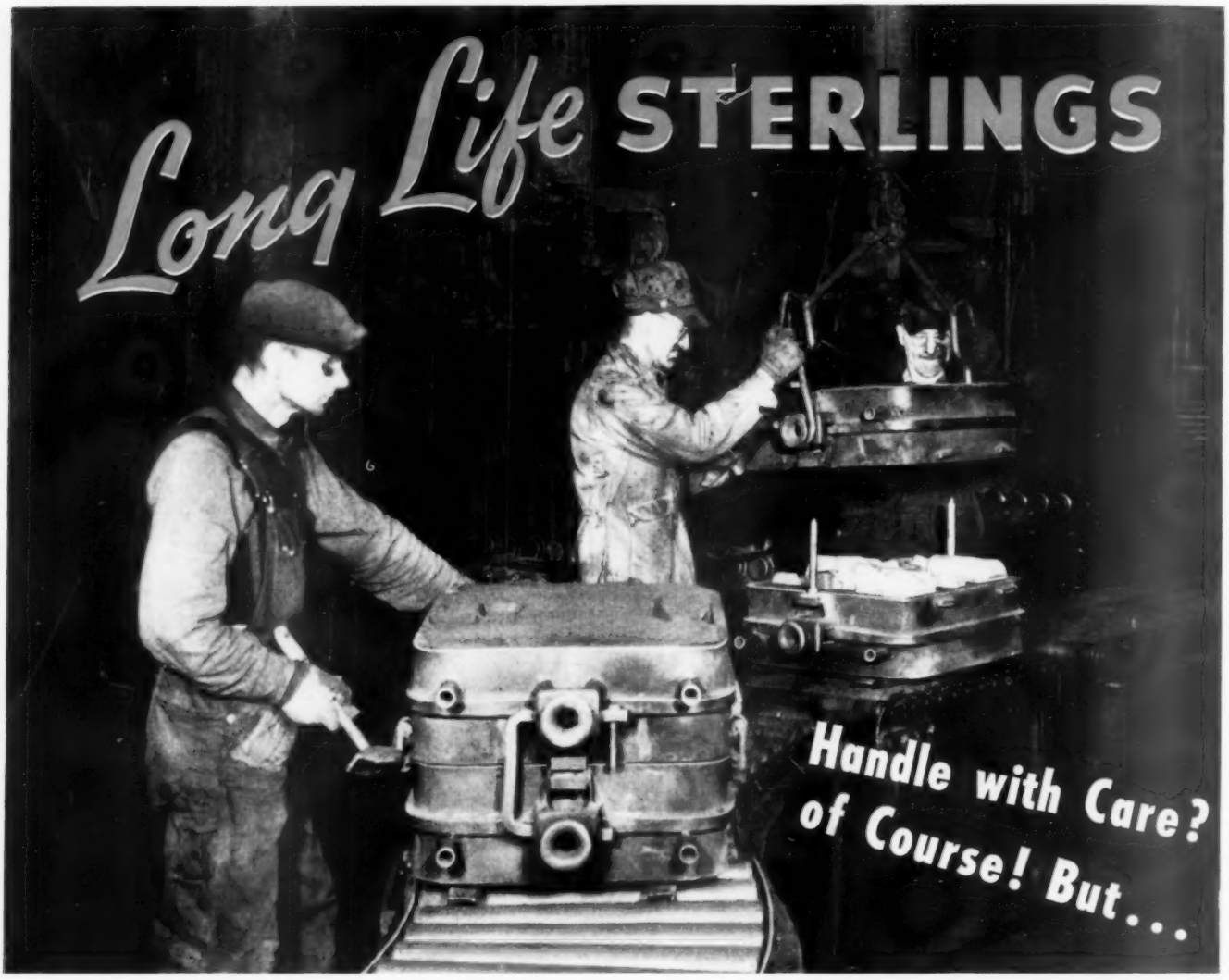

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Flasks form a major part of your foundry investment. That's why they *should* be handled with care. While every foundryman tries to avoid unnecessary abuse, he realizes that his flasks are constantly being subjected to severe punishment.

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Foundries Are Better Prepared for Emergency

REGARDLESS of the duration and outcome of the Korea campaign, the war now in progress will have a profound effect upon the lives of every American and the fortunes of all industry. Reverses in the field have revealed shocking weaknesses in our military planning and in the equipment provided our fighting men. Although Washington talks about "business as usual" while haggling over defense plans that should have been completed months or years ago, the fact remains that tremendous quantities of manpower, raw materials and industrial facilities shortly will be directed toward victory in Korea and preparedness for any emergency the future may hold.

Because industry is operating at an exceptionally high rate, controls will be required to assure adequate distribution of materials to war work and essential civilian production. Already the President has asked for authority to establish priorities, allocate materials, limit use of materials for non-essential purposes, prevent hoarding, and requisition supplies and materials needed for national defense. Controls of manpower and prices may not be very far away.

Today the foundry industry is much better prepared to meet problems of emergency production than in 1941. Top management and much of the supervisory personnel have had experience in war production, and have the know-how to meet war demands for castings without too much lost motion. Considerable technical progress in both practice and product has been made.

As the result of a great movement toward modernization and mechanization which has occupied the industry since 1946, plant facilities of a high percentage of American foundries are in excellent condition to produce large quantities of high quality castings in record time. This is in striking contrast with the situation in 1941 when most foundries had not been able to undertake improvements and expansion held in abeyance during the depression.

Foundries and their products now are better known in Washington. Through joint efforts of all groups of the industry, the Munitions Board has appointed a foundry industry advisory committee and eleven subcommittees. Great benefit can accrue any emergency effort if the various departments of government will make intelligent use of the experience and knowledge represented by the personnel of these committees.

Although the industry is stronger in experience and facilities, two projects should be given immediate attention.

Equipment should be checked, repairs made and worn or obsolete machines replaced with new and better models.

Greater support should be given the trade associations in the field. Experiences in the last war show the importance of these organizations in dealing with problems created by government controls.

Frank G. Steinebach
Editor

Illustrative of the broadened acceptance of cast gray iron as the preferred engineering material in various applications is the heavy-duty crankshaft. This is the first of two articles describing the foundry practice of Pacific Car & Foundry Co. in producing cast crankshafts weighing from 500 to 5000 lb and 6 to 18 ft long

DIESEL ENGINE Crankshafts

Cast in Gray Iron

BY ALEXANDER FINLAYSON
Technical Director
Pacific Car & Foundry Co.
Renton, Wash.

Fig. 1—Drag half of pattern for 5-throw medium size crankshaft showing construction of bottom board. Pattern is positioned on level concrete floor for slinger molding

Fig. 2—Rough cast 9-throw crankshaft with riser as extension of fly wheel end. Test bars are shown paralleling the long axis

DURING the past decade some notable advances have been made in the metallurgy and founding of cast iron whereby it has emerged as a preferred material in a field of engineering hitherto considered the exclusive realm of wrought, heat treated steel. Besides the unique qualities of low notch sensitivity and high damping which inhere in gray iron to a degree unapproached in other ferrous metals, the augmented tensile, endurance and elastic properties attainable through improved metallurgical technology have recommended it to machine designers for some of the most critical components of prime movers. An example is the diesel engine crankshaft, the production and character of which as a gray iron casting is the subject of this article.

It is, of course, recognized that cast crankshafts, as well as camshafts, have been employed in truck and automobile engines for many years and that millions of such castings so applied have manifested the sufficiency of both the material and the method. But the cranks to be considered here are a great deal bigger than the motor car variety in all respects, ranging in rough weight from 500 to 5000 lb and in overall length from 6 to 18 ft. These units are designed with hollow throws and journals for engines having 5 to 12 cylinders and energy ratings up to 2400 horsepower. The solid portions vary in thickness with other sections between 1.5 and 7.0 in. in individual castings thus presenting a series of manufacturing perplexities not encountered, or at least quite different from those involved in producing the smaller automotive types.

The basic foundry techniques for casting these heavy-duty crankshafts, including the procedure for horizontal pouring and vertical cooling, were developed by Campbell, Wyant & Cannon Foundry Co. and brought to a high degree of efficient large-scale production during the late war. That company also established the general molding and coreroom practices and compounded the special sand mixtures which, after various essays with other combinations, were adopted by the Pacific Car & Foundry Co. as the most reliable and competent.

In one or two respects, however, the inclusive method for these castings, as currently pursued at our plant, differs essentially from that set up by the originators. Significant modifications concern melting and heat treating, the former being conducted in a basic-lined electric furnace, as distinct from the acid process most commonly employed for producing high-strength alloyed iron. The latter, a low-temperature thermal process, the full purpose of which is explained further on, is an added refinement applied to all cranks, regardless of composition, as a final operation.

Design and Pattern—While every step in the complicated process of creating an acceptable crankshaft must be performed with skill and understanding, none needs more attention than the pattern. If the design incorporates a fair compliance with the rules of symmetry, applying the laws of solid contraction and heat dissipation to insure the proper feeding and uniform cooling of all sections, many of the common troubles arising from hot tears, internal cavities and irregular tensile properties are avoided. In general, large cranks designed as hammer forgings cannot be cast advantageously because of disproportions between webs and bearings, and require considerable modification to promote section uniformity. And it should not be impertinent to note in passing that were such uniformity contrived in the original wrought designs, many service failures due to stress concentration at abrupt section changes could be avoided without recourse to new or different materials.

With a casting, of course, metal can be placed where it is useful; left out where it is known to be redundant. The pattern provides a convenient means for nice adjustments in this respect and permits unlimited refinements in the shape and contour of unmachined surfaces. For dimensional permanence it is invariably constructed from the best grade of

Fig. 3—Cope and drag sections of standard 18-ft flask for diesel engine crankshafts. Trunnion brackets are shown on drag half in foreground

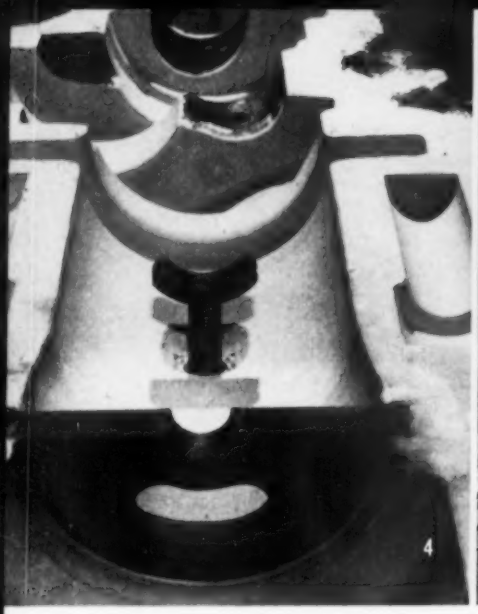
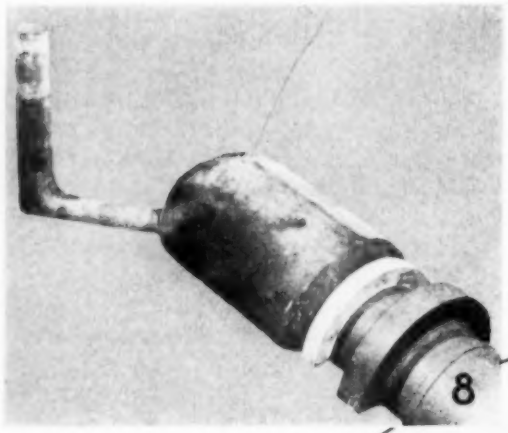


Fig. 4—Head end of drag, showing one half of graphite core in place
Fig. 5—Applying facing sand preparatory to ramming with sand slinger



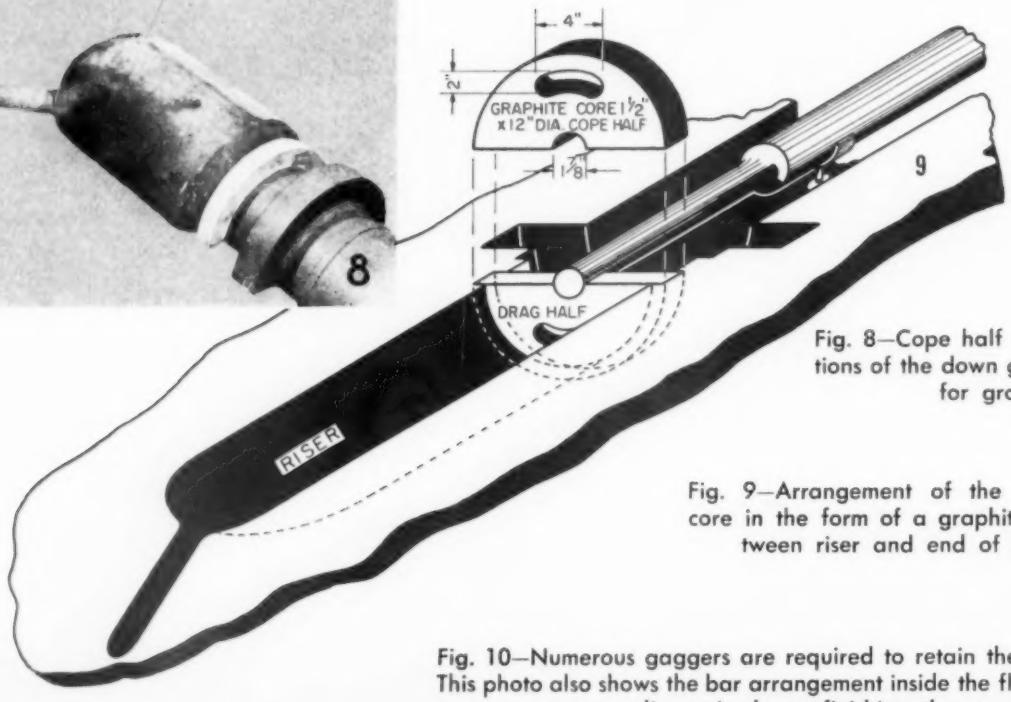
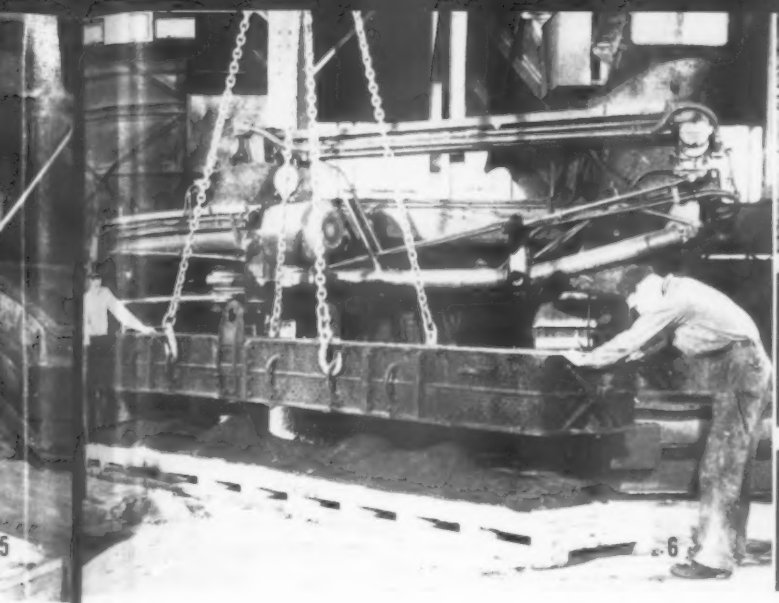


Fig. 8—Cope half of riser, showing positions of the down gate and the core print for graphite core

Fig. 9—Arrangement of the Washburn core in the form of a graphite disk between riser and end of crank

Fig. 10—Numerous gaggers are required to retain the sand in the cope. This photo also shows the bar arrangement inside the flask. Fig. 11—Sand slinger is shown finishing the cope



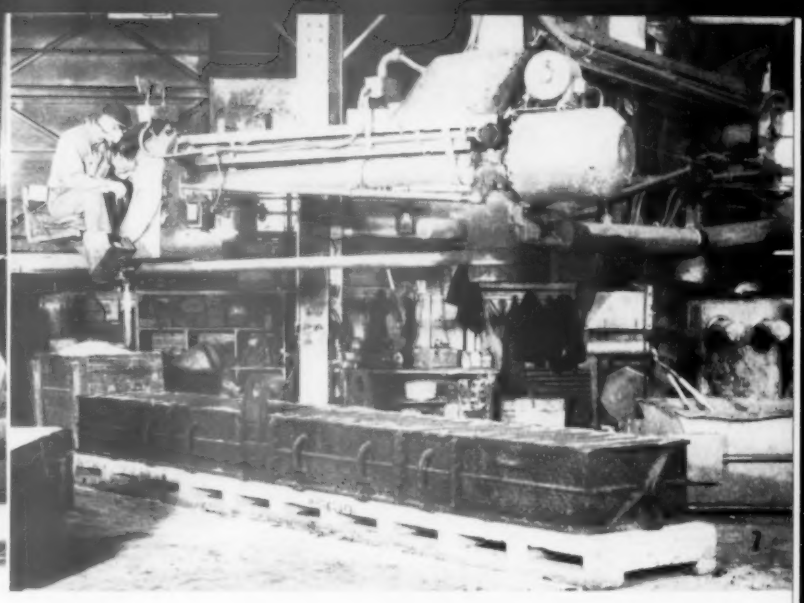


Fig. 6—Placing drag half of flask over corresponding portion of pattern. A layer of heap sand covers the facing. Fig. 7—Sand slinger in operation over drag

seasoned mahogany and mounted on rigid bottom boards to prevent deflection during the molding operations. Lack of adequate stiffness can result in bent or twisted castings, the longer patterns being, of course, much more susceptible in this regard.

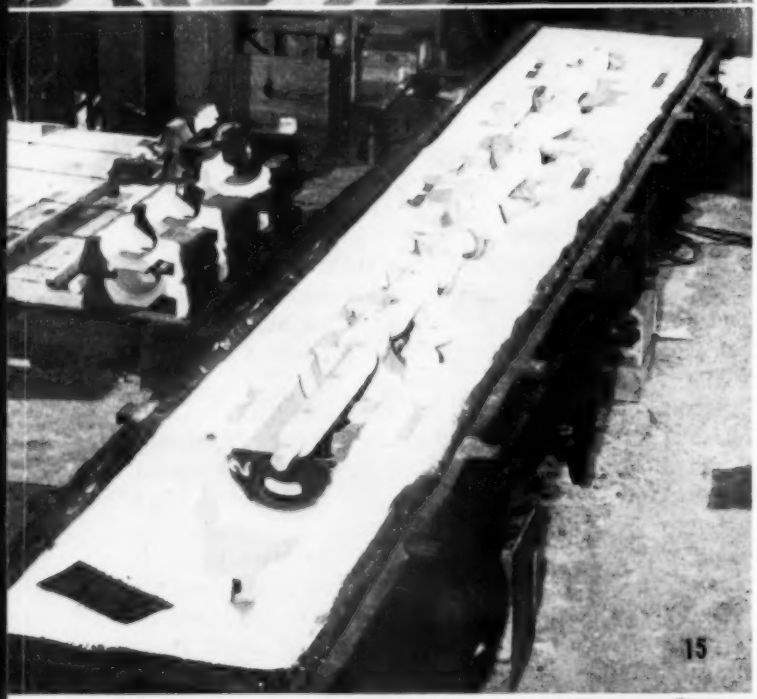
Cranks up to 90 in. in length are machine molded, and the pattern in such cases is bolted to a stoutly ribbed steel platen. Molds for longer cranks are produced on the floor with a stationary sandslinger, the pattern here being mounted on a wooden board built up with heavy, double stringers as pictured in Figs. 1 and 5.

Shrinkage allowance for crankshaft patterns is largely a matter of experience. It will vary in the first place with the design characteristics of the casting and in the second place with the composition, melting practice and pouring temperature of the iron. With the shorter units, small variations in these latter factors are not significant since minor discrepancies in length can usually be offset by adjustments in machining. But when the length exceeds 9 or 10 ft, close regulation of the established chemistry and metallurgy is indispensable for maintaining consistency in longitudinal dimensions. Comprehending all conditions, the shrinkage allowance for high-strength cast iron crankshafts such as we produce will range from 1/10 to 1/16 in. per ft.

Molding—The molding practice adopted in this foundry, from the procedures developed by Campbell, Wyant & Cannon, applies the principle of horizontal pouring and vertical cooling. In this the mold is filled through a single gate leading into a single riser, which forms an extension of the shaft on its long axis at the drive end. Since the resultant casting (Fig. 2), including the riser, is exceedingly long in proportion to its lateral measurements, rigid flask equipment is required to support the sand loads and prevent sagging or rupture during shop management of the mold halves. This is particularly so with the special sand mixtures we employ; the facing, in the green condition, is very dry and friable.

With machine molding for the lighter, shorter cranks, such contingencies are not so present, but with slinger operations and the crane handling occa-

Fig. 12—Drawing the pattern requires great care to prevent damaging the mold. Fig. 13—Cores are set after the initial 8-hr drying of cope and drag



sioned by increasing le gth, n uch difficulty involving breaks, metal run-outs and the straightness of the rough casting can be avoided by supplying adequate resistance against mold flexure at all stages and by providing a solid, level floor beneath the pattern. Fig. 3 shows both the cope and drag sections of a standard 18-ft flask while Fig. 10 is a view inside the cope showing bar arrangement. Attached to the drag half in the foreground may be seen one of two opposing brackets near the center. Through these a round bar or pipe is later passed to form projecting trunnions whereby the mold may be rotated to the vertical position after pouring as will be explained more fully in the sequel.

Originally, a complicated gating system, including traps, catch basins, strainer cores, dams, etc., was employed to prevent the introduction of eroded sand or slag and to control the metal pressure by a series of chokes. In general, such expedients were found to be more productive of disaster than beneficial. The simple head and gate arrangement pictured in Figs. 4, 8, 9, and 15, was selected after much experiment, and except for congruous adjustments to accommodate variations in the sizes of the cranks, is fully standardized.

Using this system, the yield in rough castings in relation to the weight of metal poured is about 82 per cent. It will be seen to comprise a down gate of adequate diameter to permit rapid filling of the mold cavity but choked sufficiently before connecting with the riser so that the gate and the runner box—to be described presently—will remain full during the entire pouring operation. To facilitate removal of the

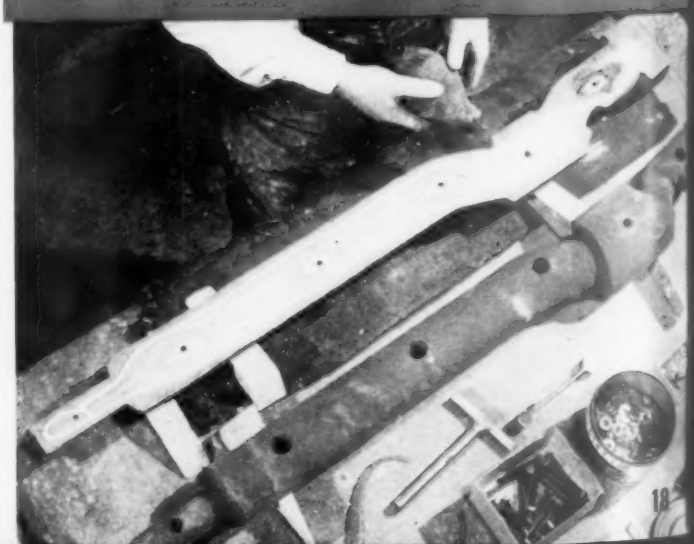
Fig. 14—Applying mold wash to the drag assembly

Fig. 15—Drag half of mold for 10-throw crank with cores in place; graphite core supports long extension

Fig. 16—Finished copes and drags on drying oven racks

Fig. 17—Cutting vents in long crank extension core

Fig. 18—Pasting a half core preparatory to assembling



riser, a Washburn core made of graphite and provided with two in-gates separates it from the casting. Total area of the kidney-shaped slots in the graphite core is calculated to promote a minimum of turbulence in the flowing metal but may be anything in excess of the choked section of the gate. Unnecessary proportions, however, will serve only to increase the time of head removal in the cleaning room and thus to some extent defeat the chief purpose of the Washburn method. The graphite disc also fills a secondary need in aiding the support of the long end core seen in **Fig. 15.**

Early attempts to use a sand core in this location were unsuccessful due to insufficient hot strength and the intense spalling action set up by thermal shocks and steep heat gradients between the up and down stream surfaces while pouring. The graphite core, however, cut from 12-in.-diam electrodes, are unaffected by these conditions and are a great deal less expensive to prepare. They do not crack or spall, and any eroded material is dissolved harmlessly in the flowing metal. It should be observed that, since heat conductivity of graphite is about 100 times that of sand, cores of this material could be 4 or 5 in. thick without establishing effectual difference in heat between the casting and the riser.

Molding of the crankshaft begins with the manual application of carefully prepared facing sand laid over the pattern to a depth of about 3 in. This is followed by a covering of backing, or heap sand shoveled on to prevent untoward displacement of the facing and re-exposure of the pattern by the subsequent force of the slinger. This (*Please turn to page* 150)

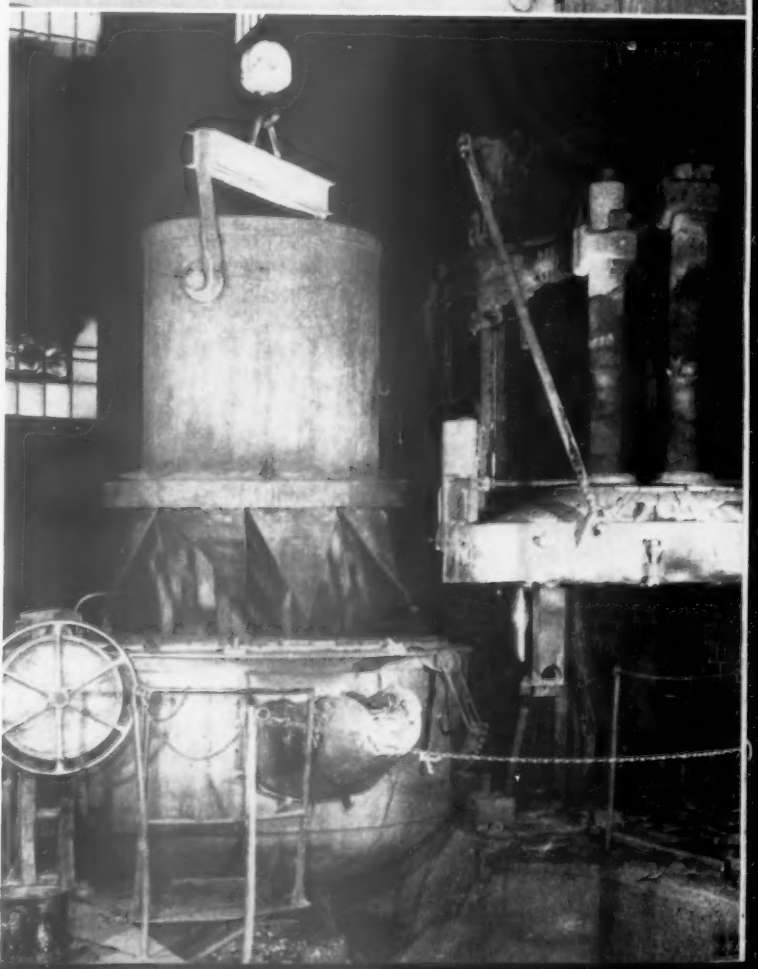
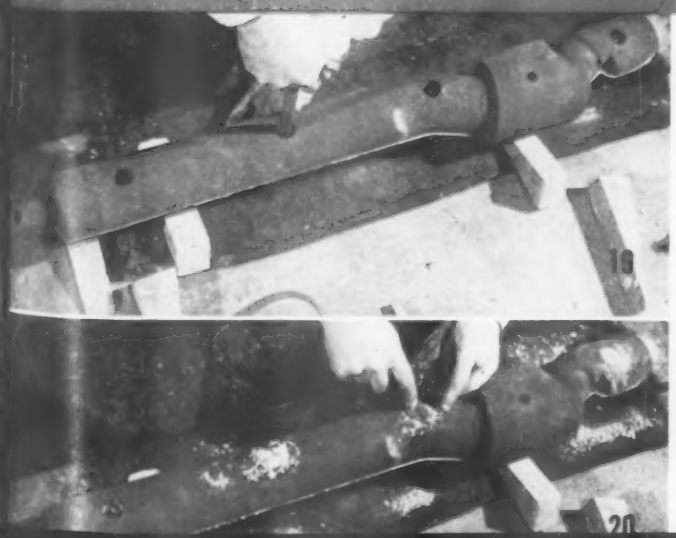


Fig. 19—Split cores are bolted together tightly in order to prevent metal penetration at the joints

Fig. 20—Countersunk bolt holes are filled with a core sand mixture before washing and second drying

Fig. 21—Apply heavy coat of core wash after assembly

Fig. 22—Pig iron and scrap are charged into furnace



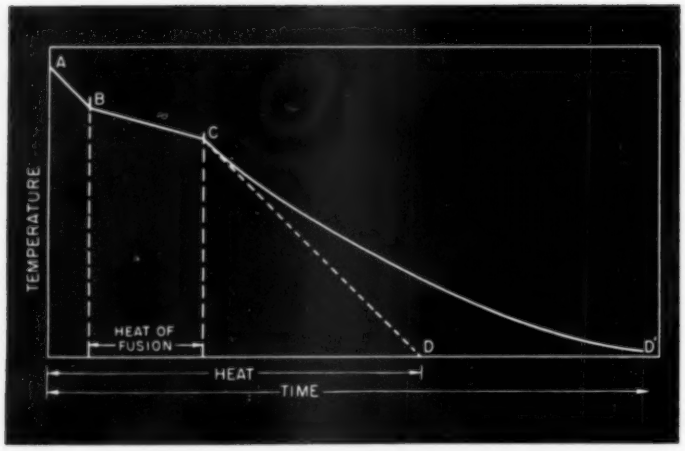


Fig. 12—Cooling curve for metallic alloy. *A*—Pouring temperature. *B*—Start of solidification. *C*—End of solidification. *D*—Temperature of mold

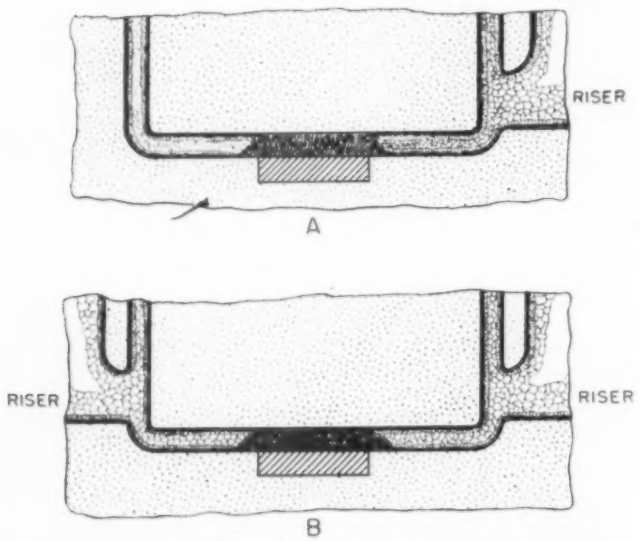


Fig. 13—Effect of chills on soundness. *A*—Shrinkage at left due to feeding being cut off by chill. *B*—Sound casting resulting from complete feeding

USE OF CHILLS IN TIN

METHODS may be found to feed almost any casting section, regardless of its shape, if such a section exists by itself, or if it is located in the casting so that the methods discussed can be applied. There will, however, be numerous occasions when some section of a casting prevents application of these required methods of feeding.

There may be bosses which are necessary for the particular service for which the casting is to be used. There may be tapered sections which will be impossible to riser to secure correct directional solidification. And there probably will be uniform sections of comparatively large expanse which cannot be filled slowly by top pouring, especially since many of these uniform sections are located in such a position that they can be molded no way except horizontally. To produce such sections without porosity, it is imperative that we have other means of providing feeding or, more correctly speaking, of controlling the direction of solidification. Use of chills is probably the simplest and sometimes the only answer to such a problem.

Strictly speaking, a chill is any material which, coming into contact with molten metal, has the ability to absorb heat rapidly from the metal and thus increase the rate of solidification at that point. The chill may be made from metal or from some other material having high heat conductivity and high heat capacity. Chills are of two types, external and internal. As the name implies, an external chill is one which is

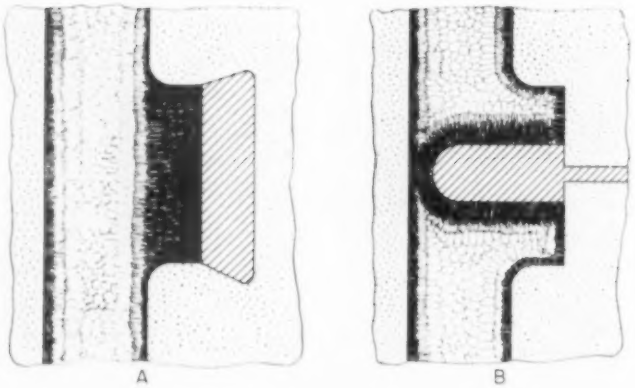


Fig. 14—Use of chills to prevent shrinkage in bosses. *A*—External chill. *B*—Internal chill

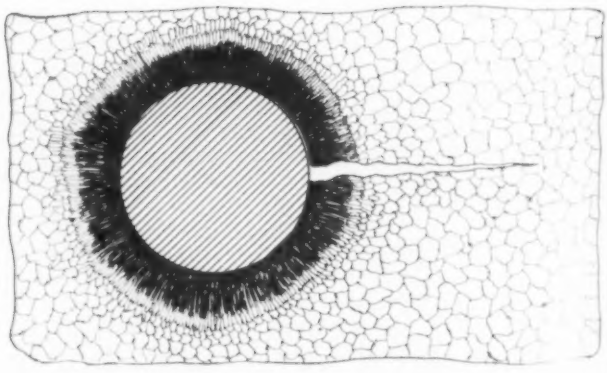


Fig. 15—Crack in casting resulting from expansion of internal chill

By CLYDE L. FREAR
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Bureau of Ships
Department of the Navy
Washington

IN PRODUCING BRONZE CASTINGS

Recommended practice in use of chills, chaplets and antichills is described by the author. This is the fourth and final article of a series devoted to the influence of various factors during the solidification of tin bronze castings. The first article was presented in the May issue

rammed up in a mold and becomes a part of the wall of the mold cavity, the metal being poured against it. An internal chill is one which is placed in the mold cavity and which actually becomes a part of the casting after the metal has been poured around it.

External Chills—Numerous materials are suitable for use as external chills. Richmond[7] reported work on various materials suitable for bronzes. Conclusions drawn from his experiments list steel, graphite, carbon and sand, the first-mentioned having the greatest chilling effect of those listed, the effect decreasing in the order given. It is likely that these materials were selected for test as having the greatest availability. His tests also indicated that gray iron had approximately the same chilling effect as did steel.

Other suitable materials, and probably more readily obtainable in the bronze foundry, would be copper and bronze. Because of their high heat conductivity, these materials should rate above steel or gray iron as regards chilling effect. The chief difficulty in their use is that, because their melting points are closer to that of bronze, also because their tendency to alloy with the molten bronze is greater, there might be a greater tendency for the chills to "burn in," making it difficult to remove them from the casting. This property might also be conducive to rough surfaces where the chills are in contact with the casting.

There would be little or no danger of ferrous alloy chills combining with the molten bronze. Graphite and carbon would have no tendency in this direction. With copper and bronze, on the other hand, burning in or alloying might occur, especially if the temperature of the molten metal was high, and more so if the metal was allowed to flow across the chill. In most cases, in order to obtain the necessary chilling action, the chill surface must follow the contour of the casting. In such a case, a metal which could be cast to shape by the foundry itself would be much more convenient. For this reason, bronze would be the best material for general use as chills, provided we could prevent the chills burning in.

Fortunately, there are ways of preventing this burning in, even though the chills are made from metal having the same melting point as the metal being poured against them. It would hardly be practicable to use a chill material having a melting point lower than that of the metal. Fig. 12 should provide a suitable explanation of how burning in can be prevented. This figure shows an approximate cooling curve, commonly known as a time-temperature curve, for a bronze alloy. Beginning at *A*, which represents the temperature of the molten metal at the time it fills the mold, this metal gives up heat to the mold, its temperature falling until it reaches the point *B* where the metal begins to solidify. Section *BC* of the curve represents the time during which the metal is changing from a completely molten condition to a completely solid state. If we were considering a pure metal, such as copper, this portion of the curve would be horizontal, indicating no temperature change during solidification. An alloy such as bronze, however, will change in temperature during this part of the cooling cycle, the drop being greater if a larger percentage of alloying element is present. The section of the curve to the right of *C* represents the fall in temperature during cooling of the completely solid metal, the flattening of the curve as it travels to the right indicating a slowing up of the cooling as the temperature comes closer and closer to the ambient temperature.

(*Please turn to page* 182)

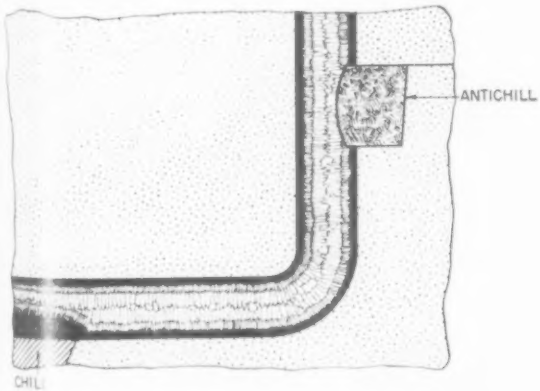


Fig. 16—Use of insulation to delay freezing at thin section of casting

BY PAT DWYER
Engineering Editor
THE FOUNDRY

PRODUCING *Textile Machinery* CASTINGS

This is the second and concluding article dealing with methods and equipment employed in the foundry department of Whitin Machine Works, Whitinsville, Mass. The first article was presented in the July issue

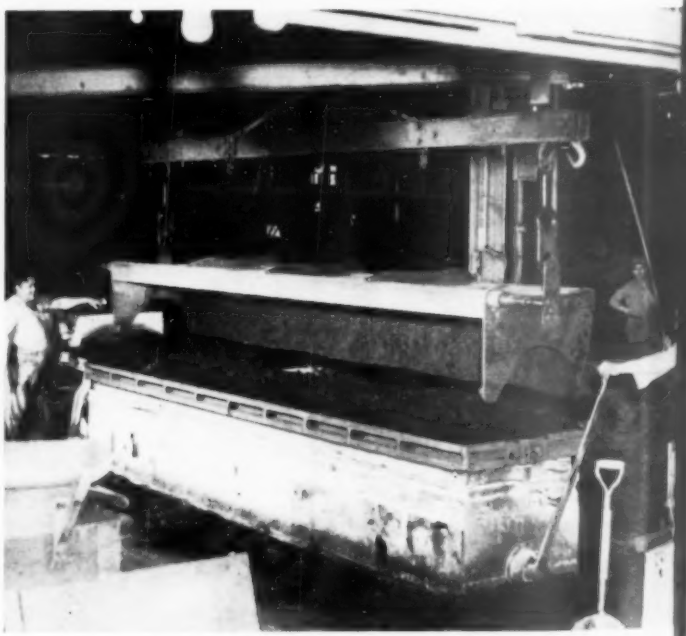
THE village of Whitinsville and the Whitin Machine Works are inseparable. Each depends on the other. Surrounding the plant the village has expanded in an ever widening circle conforming to the continued growth of the plant. The title "village" is in keeping with the conservatism and modesty of New England understatement. This modern, tidy, progressive little village has a population of over 10,000.

Approximately 1000 families live in attractive apartments and homes owned by the company, modernly equipped and rented at low rates. The town water system is owned and operated by the company. A coal and wood business is maintained for the benefit of the employees. The village has fine homes, churches, schools and public utility buildings. A business section has been built up. Schools, churches, streets, waterworks and fire department are remarkable for a village of this size. Surrounding hills form a beautiful and picturesque setting enhanced to a considerable extent by a number of artificial lakes which store water for the works.

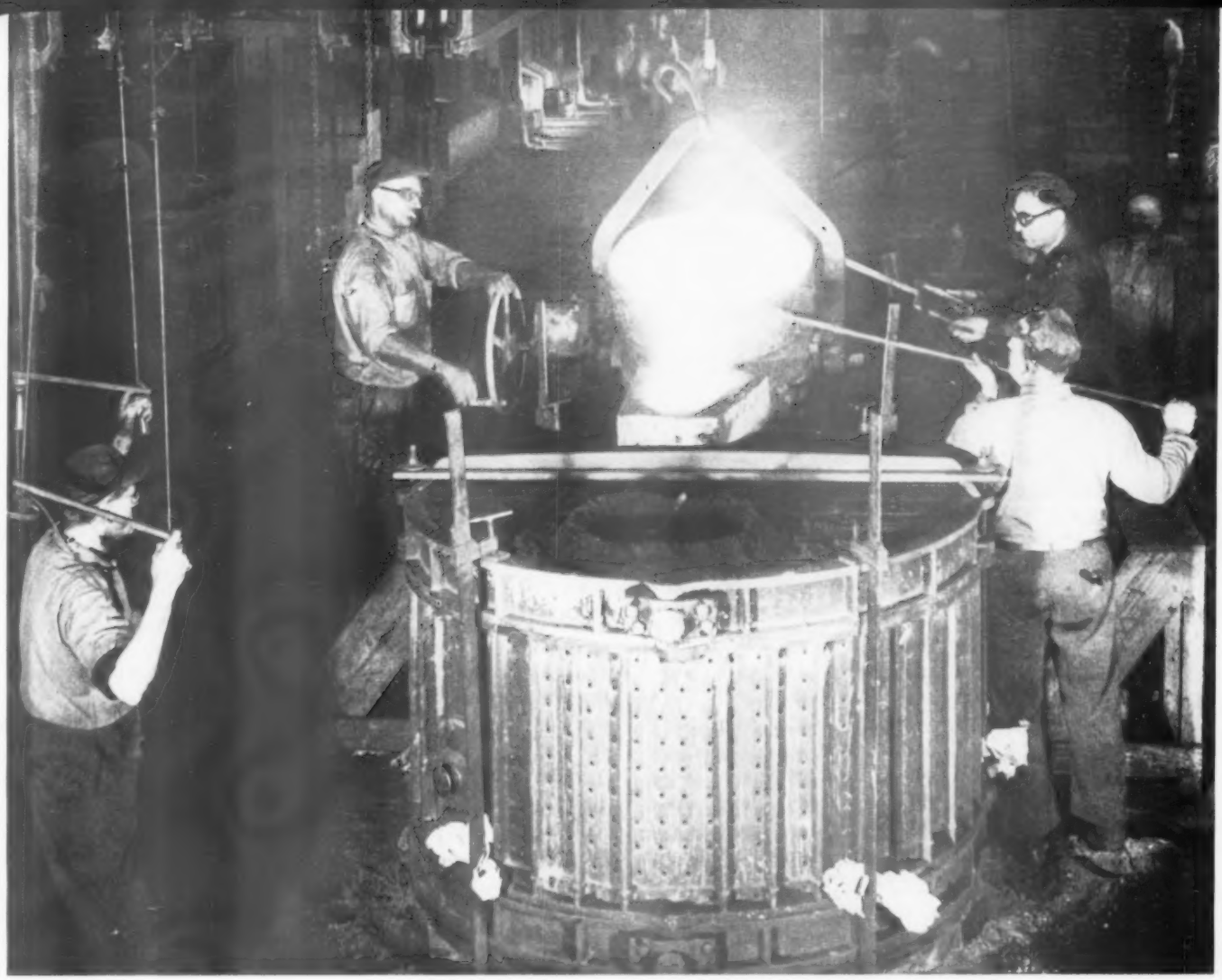
A large memorial gymnasium has been erected by the Whitin family in memory of George Marston Whitin and has become the center of social and recreational activities. The company maintains a hotel with a capacity of 160 rooms, which plays a large part in finding homes for unmarried men and helps stabilize the working force. The fire department developed and improved through the years from the hand pump stage, today is equipped with the latest and most modern high pressure engine, ladder truck and chemical apparatus.

Located 14 miles from Worcester, a city of 1000 industries, and 29 miles from Providence, some people occasionally wonder that the works do not find it difficult to keep labor contented and willing to work and live so far from the so-called attractions of large cities. The Works points with pride to its service records of 10, 20, 30, 40 and 50 years. Several men have been employed continuously for over 60 years. Worthy of special note is the fact that E. Kent Swift, chairman of the board of directors, this year is attaining a 50-year employment record with the company.

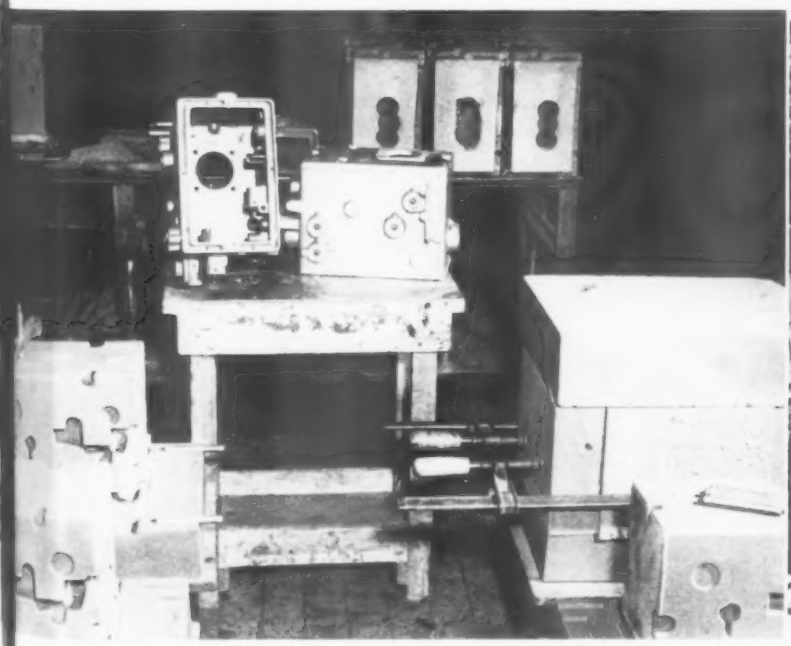
For well over 100 years expansion of the plant and line of products for the textile industry continued through periods of peace and war, through good times and bad. In 1941 Whitin Machine Works entered one of the most important and interesting periods in its long history. In this period 85 per cent of its vast facilities was converted to the production of a wide variety of critically needed war material.



Crane suspended scoop carries enough sand to fill the flask. A roller compresses sand in flask

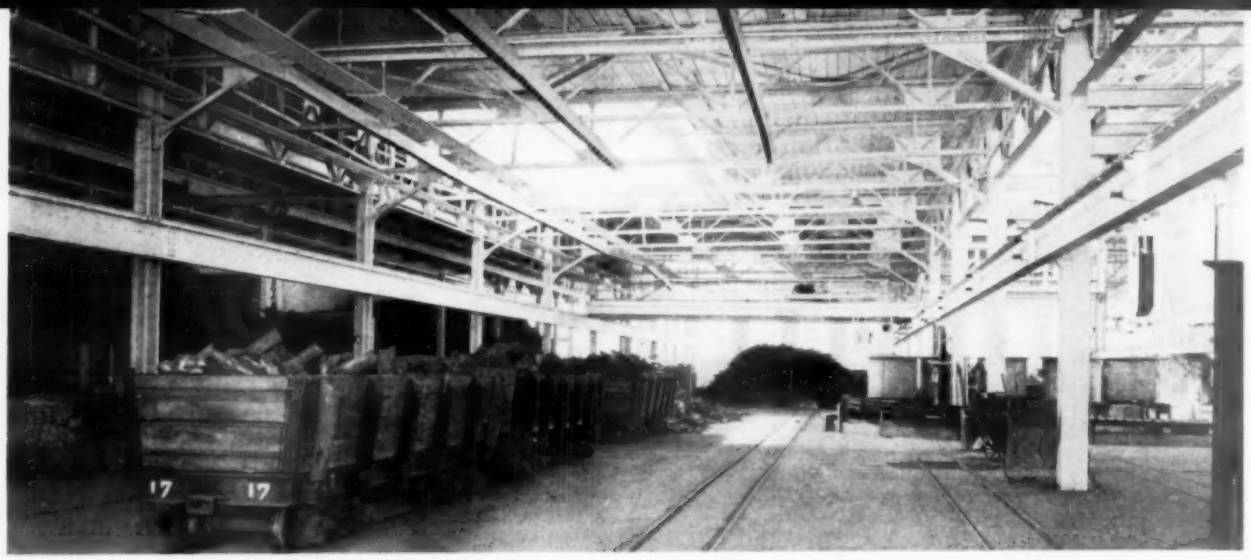


When the molds are poured, metal from the pouring basin descends through a long sprue and enters the bottom of the mold through a ring of small, shallow gates



Winder gear box castings made to very close tolerances are poured in an oil sand core assembly

Small cores are made on a battery of core blowing machines located along one side of the coreroom



Materials for charging the cupolas are brought from outside stock yard in open top cars and loaded by magnet crane to steel charging buckets shown at right

As a result of more than a century of experience and expansion of plant and facilities Whitin was able to contribute to the war of production 56½ acres of manufacturing floor space, 3400 machine tools, 4500 trained employees, a foundry with a daily melting capacity of 150 tons gray and alloyed cast iron, and the know-how to do precise mechanical work. Products included steam engines, turbines, magnetos, oil pumps, bleeder plugs and flanges.

Gaps left in the ranks by the 1565 who left to join the armed forces, and of the 41 who made the supreme sacrifice, in many instances were filled by wives, mothers, sisters and daughters.

On Nov. 7, 1942 upon the occasion of the first Maritime *M* award, 123 men were present, including President Swift, with service records of over 40 years. Several men had over 60 years continuous service records. The company also was awarded the Victory Fleet flag and Maritime Labor badges. Later at 6-month intervals, four stars were added to the pennant, to mark continued outstanding production achievement. When the war drums throbbed no longer, the production of textile machinery was resumed.

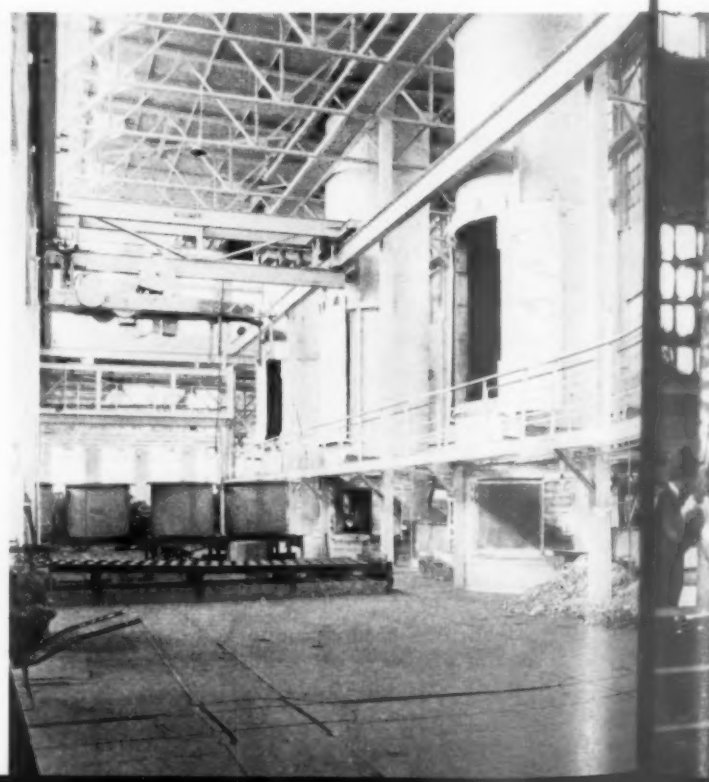
A certain amount of readjustment was necessary, partly because of the production shift from one class of castings to one differing in many respects. A second and perhaps more important reason was in response to a management policy ever on the alert for advancement and improvement in every detail of foundry technique.

While the sand in most of the molds is rammed on molding machines using the squeeze or jolt principle, the sand on machines producing long rail castings is rammed or compressed by a different method. The rail casting, in lengths up to 14 ft, is made up of two parallel members joined by several transverse members and in a general way resembles a ladder. It is a comparatively shallow casting, with the entire mold cavity in the drag and the upper face covered by a flat cope. Bars in the drag flask eliminate the need of a bottom plate. The drags on many other flasks used on various machines are equipped similarly. To facilitate the ramming operation the bars are wedge shape in cross section, wide at the top and tapered toward the lower edge.

Sand in the rail flask is rammed by a cast iron roller propelled by an articulated arm. At the beginning of the forward stroke, units of the arm, rising in a perpendicular position from a pit, lock into rigid horizontal position and push the roller to the far end of the flask. Then the motion is reversed and the roller is pulled back to the starting position.

A long scoop is employed to fill the flask from a pile of sand in the immediate vicinity. This is the shakeout sand from the previous day's operation. It is prepared and kicked into position by a rotary type, portable sand cutting machine. The long scoop, with

Drop-bottom charging buckets are picked up from the roller conveyor and dumped in the cupola



two trunnions at each end, is manipulated by a crane, a long beam and a pair of slings. The trunnions are mounted on two gravity center lines. When the slings engage one pair of trunnions on the empty scoop the lip hangs down near the floor. In this position it is moved forward to collect a load of sand. The slings are transferred to the other pair of trunnions to bring the lip up when the scoop is lifted by the hoist. When the loaded scoop rests on the flask, the slings are again transferred to tip the scoop and discharge the load of sand into the flask. The entire operation takes about the time required to read the foregoing paragraph.

The scoop holds sufficient sand to fill the flask about 4 in. above the top. After the roller has passed back and forth four times, the top layer of the extra sand is approximately flush with the top surface of the flask. Two operators wield a straightedge to remove the small amount of surplus sand and form a flat surface. The same beam and slings employed for manipulating the scoop are attached to the end trunnions on the flask, to lift it from the pattern plate, turn it over and lay it on a bed prepared on the floor.

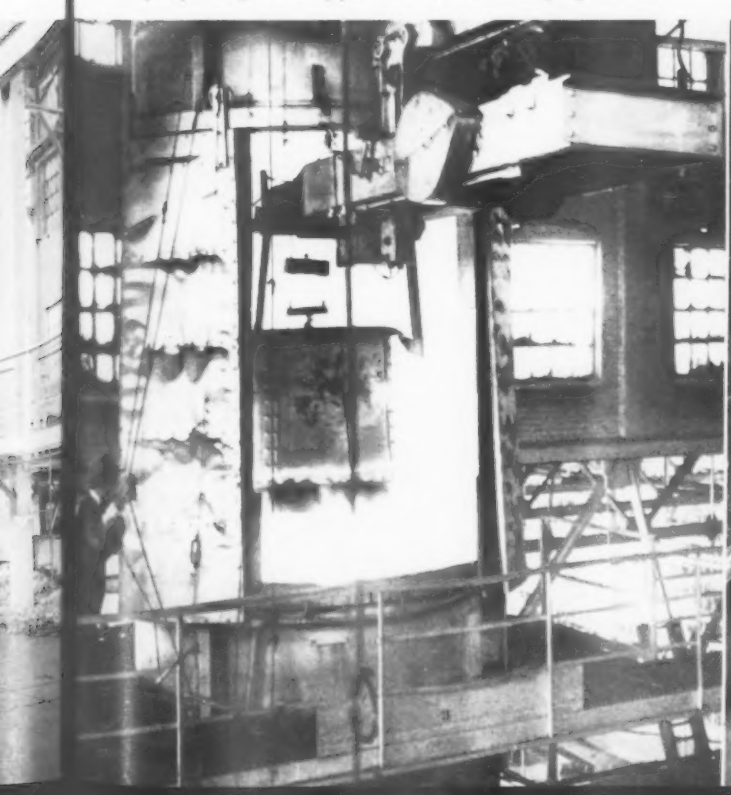
Drag molds for one-half the days work are placed on the floor, then are covered with copes made on a flat back plate and rammed with the same roller previously described. This procedure makes it possible to start pouring at an early hour. Then the balance of the molds are made in the same fashion. All flasks are interchangeable. The rail castings are ordered in various lengths up to 14 ft, but all molds are made from the maximum length patterns. Small stopoff cores dropped into the side members at designated points, limiting the castings to any specified length. Metal is poured into a sprue at the end near the gangway. At the joint line the metal enters two branch gates, one gate leading to each of the horizontal side members.

Card cylinders in various lengths and diameters up to 60 in. are made in green sand in three-part cast iron flasks—drag, cheek and cope. In the assembled form two castings are bolted together to form the complete unit. The outside surface is machined. Wood plugs are driven into a large number of small holes in the face. Later a special bristle fabric is attached to the wood plugs. The iron pattern is in two parts, the cylinder proper with a hub and set of bent arms on the top, and loose rings at the bottom to form the internal flange by which the two cylinders are bolted together to form the complete unit.

The cheek is not lifted off. Sand in the cheek is jolted, but the sand in the cope and drag is rammed by pneumatic rammers. Occasionally when the sand-slinger is not otherwise engaged the molds may be made under that equipment. In these instances the cheek sand is rammed on a power-operated turntable. For sprue, gates, pouring basin and the casting itself, 2400 lb of iron are required.

The cheek, upside down, is rammed first and a parting made for the bottom loose ring. The drag then is rammed and lifted off and the ring pattern is removed. The long central sprue is connected to a ring gate or runner, and a number of thin flat gates convey the metal from the runner into the flange at the bottom of the mold. Drag and cheek clamped together then are rolled over. The cope is rammed, lifted off, and the main pattern is removed. After the cope is returned to place, a basin is built on top from the edge of the flask to the central sprue. To prevent erosion from the large volume of metal, the lightening ridge of sand (*Please turn to page* 190)

Hooks from the charging crane engage a flange projecting from upper rim of the charging bucket



Quadrant enables one man to lift loaded crucible out of one of the oil-fired nonferrous furnaces

Brake

By FRED J. WALLS
International Nickel Co.
Detroit

CAST iron embodies a large family of engineering materials with controllable characteristics that make it possible to specify physical and mechanical properties to meet quite definite requirements. The 1949 *SAE Handbook* lists seven different specifications based principally upon tensile strength, except two (Nos. 113 and 114) which were added last year as specifications for brake drums and clutch plates (page 459 of the handbook). Both of these specify a minimum total carbon content of 3.4 per cent and were designed to provide irons to resist heat checking. Experience over the past decade has proven that the higher the graphitic carbon the more resistant is the iron to heat checking. In all probability the reason for this is that, in general, the higher the graphitic carbon the lower the modulus of elasticity. Therefore the thermal stresses are lower as we have already mentioned, but there may be a more important reason. Since we can assume that the graphite behaves somewhat like a liquid, the stresses become more readily distributed. This, also, could account for the high compressive strength of cast iron.

The fact that cast iron is three to five times as strong in compression as it is in tension may account for some of its merits as a drum material in contrast to other materials which have about the same compressive and tensile strengths. Generally speaking, the weaker irons have the higher ratio, or an iron of about 20,000 psi in tension will exhibit a compressive strength of about 100,000 psi.

When low or medium carbon steels were used in drums for aircraft prior to 1940, there was a continual shrinkage of the inside diameter when subjected to high energy inputs. This is due to an upsetting process of the friction face or high heat effected zone. As a consequence it was found necessary to regrind as often as every 10 or 15 stops to maintain clearance between the drum and lining. The use of the high carbon cast irons decreased this tendency to shrink, which may be due to its high compression strength. It also was found that in the use of bimetallic drums of the "centrifused" type a ratio of about three times the thickness of cast iron to that of the steel backing was necessary to minimize this diameter shrinkage.

The tensile strength, compressive strength, hard-

FIG. 4 EVOLUTION OF THE BOMBER DRUM

DATE	DIAM.	WEIGHT		FT-LBS PER DRUM	KINETIC PER SWEPT SQ. IN. OF DRUM	ENERGY PER LB. OF DRUM	HORSE POWER PER LB. OF DRUM	HORSE POWER PER LB. OF DRUM PLUS BRAKE
1939 1940	20"	39 LBS.	A B-17	1,800,000	5,080	46,150	5.77	2.93
1941	20"	44	B B-17 B-24 C-46	2,221,000	6,400	50,800	8.32	4.70
1943	20"	48.5	C B-17 B-24	5,000,000	14,468	100,300	10.4	6.42
1944	20"	60.6	D B-29	7,150,000	20,689	118,000	14.1	854
1948	21½"	132.5	E B-47 B	15,500,000	32,800	117,000	10.5	6.66

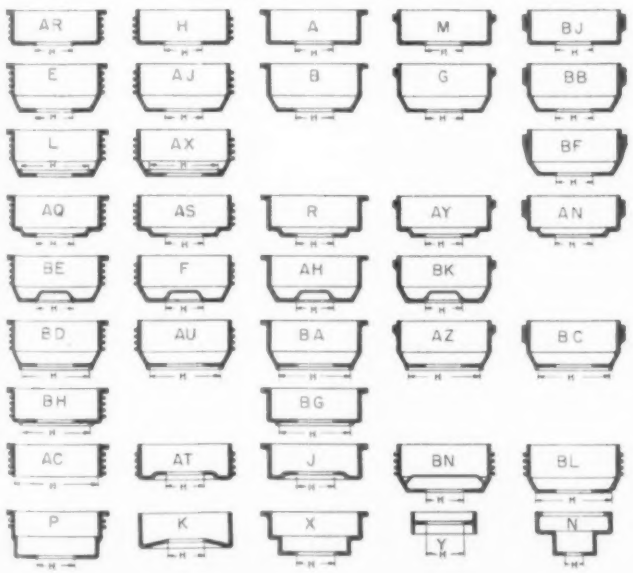
Drum Materials

In this concluding article, covering the requirements of a suitable brake drum material, the author discusses some of the experiences of brake drum manufacturers with various designs and metal compositions. The first article was published in the July issue

Fig. 3—High carbon-nickel-molybdenum sand cast aircraft drum with excellent heat checking resistance

ness, and modulus of elasticity of cast irons are, as a rule, a function of the chemistry but dependent to an appreciable extent upon choice of raw materials and processing. Because of the ramifications of the latter, which are beyond the scope of this paper, we can assume that the foundries supplying brake drums are willing to and do meet the physical, structural and mechanical requirements as specified by the vehicle producer.

FIG. 5 CHART OF GUNITE DRUM TYPES



It should be stressed that cast irons do not behave in accordance with Hooke's Law. For this reason the modulus is taken arbitrarily on the stress strain curve at 25 per cent of the ultimate tensile strength without consideration of the plastic deformation. Generally speaking, the modulus of cast iron varies inversely as the total carbon content and is somewhat independent of its tensile strength. This makes it possible to utilize high total carbon irons to meet the requirements of a low modulus and at the same time through the use of proper alloying, approach the required strengths in a single material. There are certain drum applications wherein wear resistance or strength are of more importance than resistance to heat checking such as in relatively slow moving vehicles where the rate of energy input is low.

Scoring and wear resistance probably is tied in more with metallographic structures than it is with Brinell hardness, although hardness is a measure of structure to a certain extent and is used in most specifications.

During the course of our attempts to develop a cast iron for the aircraft industry with better resistance to heat checking many different chemistries were tried out. Frank Foundries Corp. of Moline, Ill., and Hayes Industries of Jackson, Mich., did an excellent job prior to and early in the war in carrying out this development and supplied large quantities of improved aircraft drums. A specification for sand castings cast statically, which was proven to be the best compromise of all the gray irons tested from the standpoint of resistance to heat checking, is as follows: Total carbon, 3.70-3.90; silicon, 1.10-1.30; sulphur, 0.06 max; phosphorus, 0.10 max; manganese, 0.60-0.80; molybdenum, 0.40-0.60; nickel, 1.90-2.10; tensile strength, 30,000 psi min; bhn, 200-240; stress relieved at 1,000° F for 1 hr at temperature; furnace cooled.

When brake loads became heavier and weight became of an ever increasing importance it was neces-

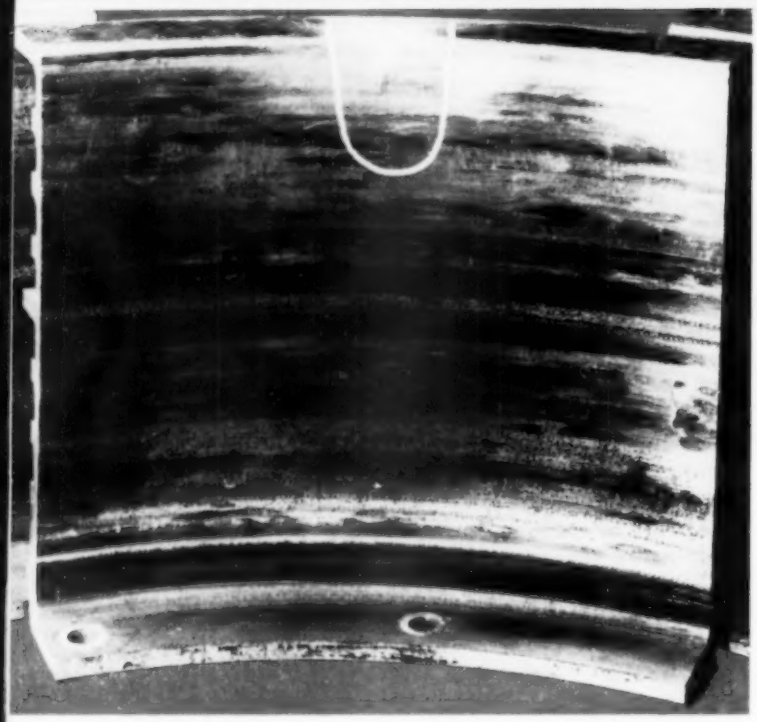


Fig. 6—Effect of thermal stresses on low carbon drum

sary to resort to bimetallic drums as mentioned previously with a compromised chemistry because of manufacturing problems as follows: Total carbon, 3.70-3.90; silicon, 1.45-1.65; sulphur 0.10 max; phosphorus, 0.20 max; manganese, 0.50-0.70; chromium, 0.30-0.40; molybdenum, 0.30-0.40; and nickel, 1.35-1.55.

Foundries producing heavy duty drums, such as are used on trucks and busses, are confronted with the production problems incidental to diversified ranges of chemical, physical, mechanical, and design specifications. A typical example of the variations in these specifications was supplied by Lynchburg Foundry Co., Lynchburg, Va. A summary of the 17 different drums produced for seven different companies shows the following ranges in chemistry and mechanical properties: Silicon, 1.5-2.55; manganese, 0.40-0.90; sulphur, 0.15 max; phosphorus, 0.275 max; total carbon, 3.15-3.70; copper, 0-1.25; chromium, 0-0.80; molybdenum, 0-0.90; nickel, 0-1.55; bhn (1.2 bar), 170-302; bhn (casting), 170-248; tensile, 30,0000 psi min, and structure, pearlite.

Lynchburg Foundry Co. offers proposed brake drum specifications as compromises that would fit into their foundry operations. (See accompanying table).

All of the dozen or more foundries specializing in heavy duty brake drums are confronted by widely scattered narrow range specifications of both chemistry and mechanical properties but without much consideration for the physical properties which appear to be of great importance in the functional operations of a brake drum as outlined earlier in this discussion.

To complicate the problems of the producing foundries still further, there are the design variables, incorporating irregular sections and ribs, which sometimes amount to fins that are questionable in their effectiveness insofar as sectional modulus is concerned because of cooling rate gradients in the casting process that promote inherent stresses. A chart of Gunite drum types (Fig. 5) taken from the Gunite Foundries Corp.'s Brake Drum Catalog No. 497 illustrates 38 different drum designs. They have this to say about ribs and fins: "The Gunite heavy ribbed drum is designed to obtain maximum rigidity with minimum weight. The Gunite ribbed drum is 60 per cent more rigid than a plain type drum of comparable weight. It therefore resists distortion when brakes are applied." And: "As a matter of fact, they actually interfere a little with the cooling of the drum because they block off some of the circulation of air in the narrow space between the (*Please turn to page* 118)

Proposed Brake Drum Specifications

(Lynchburg Foundry Co., Lynchburg, Va.)

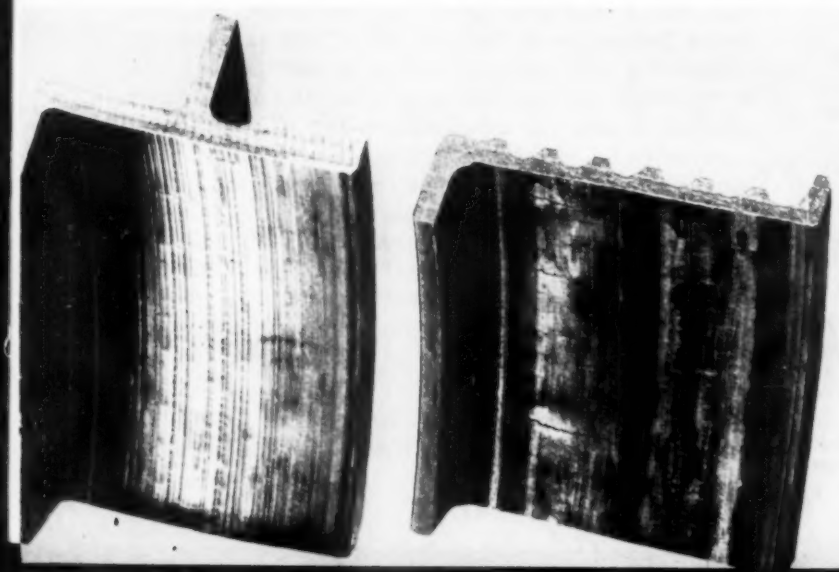
	Chemical Range		
	Heavy Duty	Medium Duty	Light Duty
Total carbon	3.40 Min.	3.25-3.45	3.25-3.45
Silicon	1.40-1.80	1.80-2.10	1.80-2.30
Sulphur	0.10 Max.	0.10 Max.	0.10 Max.
Phosphorous	0.15 Max.	0.15 Max.	0.20 Max.
Manganese	0.70-0.90	0.70-0.90	0.70-0.90
Alloys	To meet requirements		
Mechanical Properties			
Tensile strength, psi	40,000 Min.	35,000 Min.	32,000 Min.
Bhn	200-249	190-241	190-235

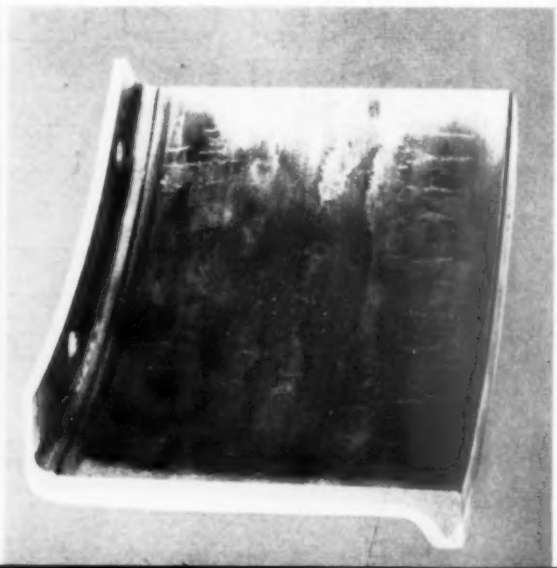
Mechanical Properties for Higher Total Carbons

Total carbon 3.50	tensile	37,000	bhn	200-249
Total carbon 3.60	tensile	34,000	bhn	200-249

Fig. 7—Drum sections, showing effect of abrupt changes in thickness in relatively low carbon irons

Fig. 8—Section of an early design of the bimetallic "centrifused" type brake drum





Steel Foundry Core and Molding SANDS

In this fifth of a series of articles the author discusses dry and green sand molding practices, the sand mixtures employed, and sand reclamation processes in steel foundries

By JOHN HOWE HALL
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IF A RAMMED mold, rather than a core assembly is to be made, the choice between dry sand and green sand molding depends chiefly upon weight of the casting and thickness of its sections. Very large, heavy pieces seldom are attempted in any but dry sand molds. On the other hand, green sand, which originally was used only for light castings of thin section, is now considered suitable for much heavier pieces. By resorting to surface drying of what are by courtesy called green sand molds, they are used to produce castings that formerly would have been attempted only in dry sand. Years ago, for instance, no one would have considered any but dry sand molds for locomotive driving wheel centers, but today they are almost always made in partially dried molds.

There are several reasons why 'simon-pure' dry sand practice has been abandoned in American steel foundries, except for making very heavy castings that require exceedingly strong molds. In the first place, to dry a mold either in an oven, or by circulating hot air through it, adds considerably to the cost of production. Ovens occupy a great deal of space, are rather expensive to maintain, and burn a lot of fuel. Extra labor is involved in moving the molds to the oven and from the ovens to the closing floor. In ovens, much of the heat is dissipated in warming up the flasks, and to a considerable extent, the sand is dried from the outside of the mold toward the center, so that the maximum time is required to get it dry at the points where it is to be in contact with the metal. Secondly, moving molds about tends to wrench them out of shape, unless very strong, rigid flasks are used. Further distortion results from the expansion and contraction of the sand when it is heated up for drying, and then cooled off. Again, completely dried sand with a high percentage of clay generally has so much strength when hot that it offers the greatest possible resistance to the contraction of a casting of complicated shape, and hence tends to produce hot tears in the steel. It is not too much to say that many of the castings now regularly produced in steel foundries could not have been made economically in old-fashioned dry sand molds.

When dry sand practice is to be used, molds made in flasks too large to be put in the available ovens and those rammed up in pits without flasks, may be dried either with coal or coke fires in old-fashioned "salamanders", or by means of portable dryers that circulate hot air through the mold. These are usually though not necessarily gas-fired, and are generally so arranged as to send the air down one or more of the sink heads, and force it through the whole mold and out through the gates and the other heads.

Several days usually are required to dry the sand in a big mold deep enough that the moisture will not draw back into the surface layers of sand while the job is being cored up and closed. Drying a mold in this way has at least one pronounced advantage, in that the drying is from the surface in, and the layers of sand that are to come in contact with the metal are dried the most, which is not always the case in ovens.

For heavy dry sand work, experience indicates that it is essential to use sand mixtures in which clay is the principal bonding agent. It is sometimes stated[20] that by using more moisture than is required in green sand work a suitable dry sand mixture can be made up with sand and bentonite alone. Though such mixtures may be used satisfactorily for medium weight castings poured in dry sand or in partially dried molds, they have never proved successful for the production of really heavy dry-sand work. Such pieces are almost without exception made either with naturally bonded sand, or with synthetic sands in which from 10 to 12 or 13 per cent clay is incorporated. From 5 to 7 or even 8 per cent moisture is used in these mixtures, and in addition to the clay, considerable amounts of molasses, lignin, or similar binders are incorporated in them.

The green strength of such sands is moderately high, both green and dry permeability rather low, and the dry and hot strengths are high. For deep work where the sand will be under great pressure, with sections heavy enough to stay fluid a long time, silica flour generally is incorporated in the sand to reduce the liability to burning-on and penetration.

A great many moderately heavy castings are made today in what the foundryman calls green sand molds, but what are in reality deeply dried green sand. They are sometimes placed in ovens for an hour or more, or may be dried with portable hot air heaters. Car bottom ovens are very convenient for this purpose, and often are arranged so that as a car with a green mold is pushed in at one end, another with a dry mold ready for closing emerges at the other. Molds are kept (*Please turn to page* 119)

NICKEL-ALLOYED Brass and Bronze

FUNCTION of nickel in copper base alloy foundry products has been studied comprehensively and is understood thoroughly by scientific workers who investigate the properties of alloys, but the significance of some of this information has not reached the foundryman beyond the general statement that nickel additions confer useful properties upon these alloys. Some of the advantages which small additions of nickel contribute to the established family of alloys are described at some length in the following text.

Almost all of the common constructional, pressure and bearing bronzes contain up to 1 per cent nickel, and its presence is considered commonplace. In some cases, specification limits are placed upon the quantity of nickel permitted in brass and bronze casting alloys, with no purpose to support this limitation. Many casting alloy specifications are limited to a nickel content of 1 per cent maximum when, in fact, 2 or 3 or 5 per cent would confer substantial improvements and lend the foundryman a hand with his problem of producing a high quality product.

Advantages that result from the presence of nickel, such as a finer grain, greater density of the metal, better lead dispersion, less risk of overheating, correspondingly less gassiness, and improved fluidity with correspondingly less shrinkage, leading to freedom from structural irregularities or weaknesses, are of great importance to the foundryman.

The background for anticipating these advantages resides in the well-known fact that nickel and copper form a complete series of solid solutions in which progressively increasing nickel additions move the copper base material from copper base properties toward those characteristic of nickel. The interchangeability of nickel and tin has been known and practiced for some time. Table I illustrates the equivalence in mechanical properties in a typical 88 copper, 8 tin, 4 zinc bronze. Tibbetts[1] shows this result more clearly in Fig. 1.

In addition, a new family of alloys has been developed, based on the fact that nickel and tin in amounts above 2 per cent each, provide a precipitation hardening phase which exerts a strengthening and hardening effect.

The 5 per cent nickel—5 per cent tin bronzes (A proprietary alloy having the trade name Ni-Vee) are exceptionally important for their low shrinkage, high density characteristics, for the foundryman's benefit, and the versatility in mechanical properties which they provide for engineering purposes. These bronzes will be discussed further in a future article.

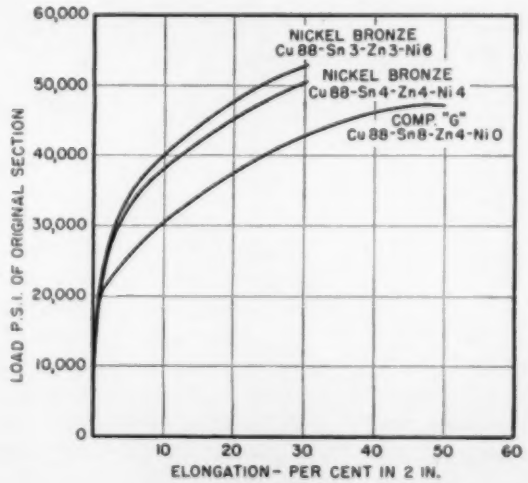

Fig. 1 — Chart illustrates strengthening effect of nickel in Composition "G" type tin bronze

Fig. 1

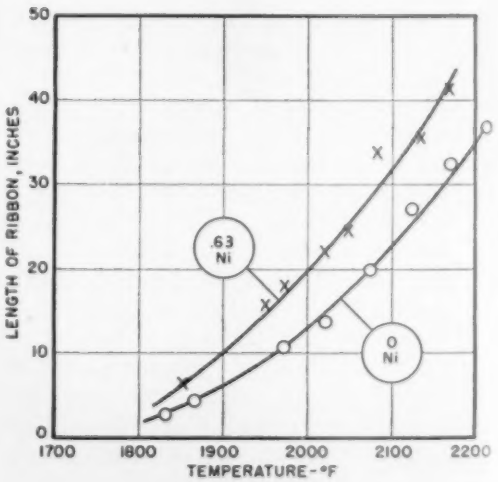

Fig. 2—Shows effect of nickel on fluidity of 89 Cu, 11 Sn gear bronze

Fig. 2

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Castings

Pilling and Kihlgren[2] demonstrated the increased fluidity that occurs for small additions of nickel, and pointed out the advantage occurring from a broadening of the pouring temperature range (Fig. 2). Conversely, a lower pouring temperature, with its inherent advantages in producing density and finer grain, may be utilized, as mentioned in the discussion by St. John[3]. Grain refinement, with its collateral effect of densening the metal and eliminating solidification shrinkage, also has been observed. A 50 per cent reduction in grain size resulted for a 1½ per cent nickel addition made to a gear bronze, cast within the usual pouring temperature range (Fig. 4). In a tin bronze, 5 per cent of nickel broadens the pouring temperature range and improves the strength and soundness (density) of the metal. Hesse[4] concludes that tin causes intercrystalline shrinkage porosity in bronze, and if the tin is replaced with nickel up to 6 per cent, improvements result in the production of pressure castings (Fig. 3).

Constructional Bronzes—Bronzes 1 to 7 in Table II comprise the constructional group in which strength or hardness are predominant factors. For this reason, they contain no lead to achieve maximum strength and ductility. This is especially necessary for the

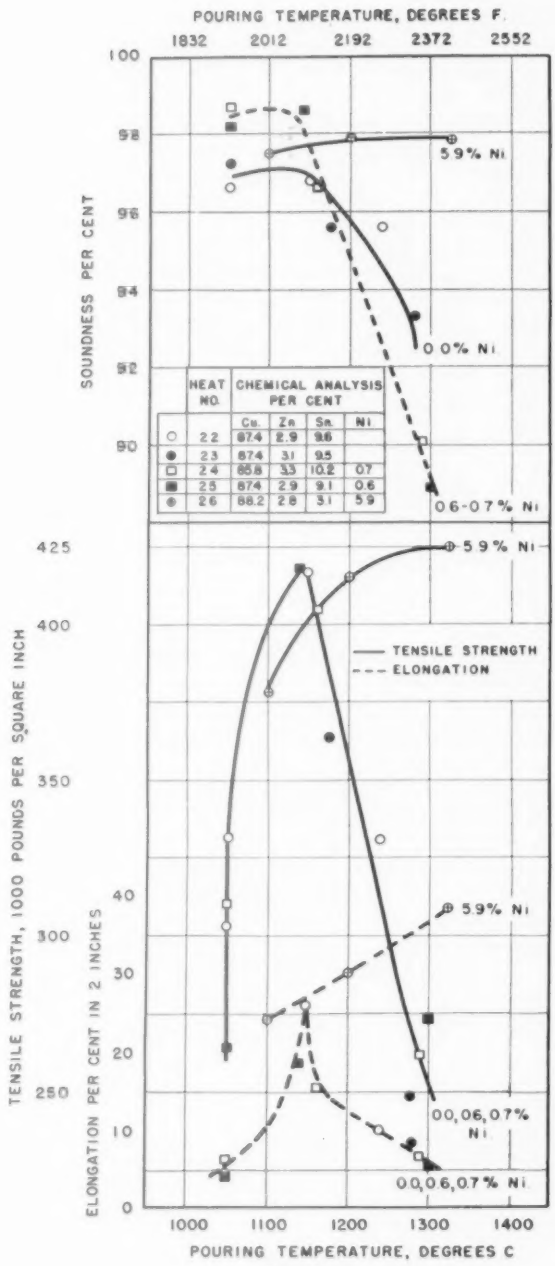


Fig. 3

Fig. 3—Effect of pouring temperature and nickel on the physical properties and soundness of a tin bronze alloy

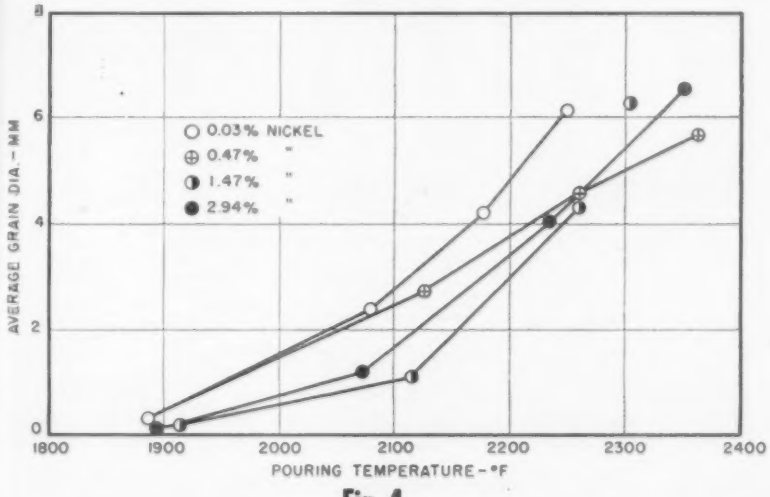


Fig. 4

Fig. 4—Chart shows effect of nickel on grain refinement in 89 Cu, 11 Sn bronze. The nickel additions are as shown

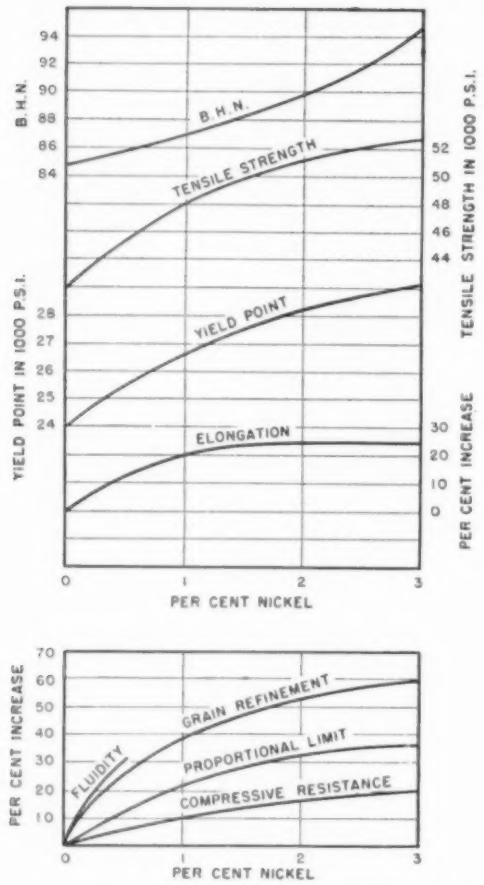


Fig. 5—Chart above shows improvement obtained in gear bronze through use of nickel additions

TABLE I—Replacement of Tin by Nickel in Bronze

Properties	8% Tin 0% Nickel	5.5% Tin 2.5% Nickel	3% Tin 5% Nickel
Yield Point, psi	17,025	17,600	17,650
Tensile Strength, psi	36,200	39,800	41,300
Elongation %	25	35	34
BHN	73	75	79
Pouring Temperature	2250°F	2378°F	2413°F

heat treated bronze listed as No. 7 in Table II.

The general effect of nickel in small amounts is to strengthen and toughen the casting. It may also increase the hardness in proportion to the quantity added. By way of illustration, the effect of up to 3 per cent nickel on an 11 per cent tin gear bronze is shown in Fig. 5. Nickel alloyed bronze ring gears conforming to American Gear Association specifications are shown in Fig. 7.

The 1 to 3 per cent nickel alloyed bronzes with 8 to 13 per cent tin provide the engineer with a number of easily cast, high strength materials suitable for chill cast, sand cast or centrifugally cast parts such as cams, gears, cylinders, bushings, as well as machine frames, brackets, hooks, marine hardware and fittings (Fig. 8). Zinc up to 2 per cent may be specified for beneficial effects upon foundry practice. Lead in small amounts benefits machinability. In some bronzes requiring exceptionally high quality, lead may be limited to less than 0.25 per cent, and other impurities such as aluminum, antimony, iron, silicon and sulphur to a total amount of 0.50 per cent or less.

Small amounts of lead, in the 0.50 to 1.50 per cent range, occasionally are used in these alloys to enhance machinability. In such cases, mechanical properties are depreciated correspondingly. These com-

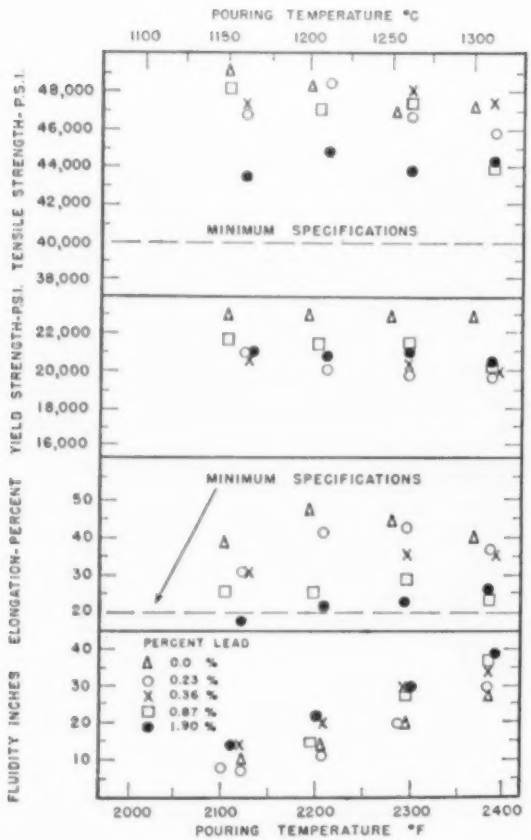


Fig. 6—Properties of 88 Cu, 5 Sn, 5 Ni, 2 Zn bronze as influenced by lead additions as shown

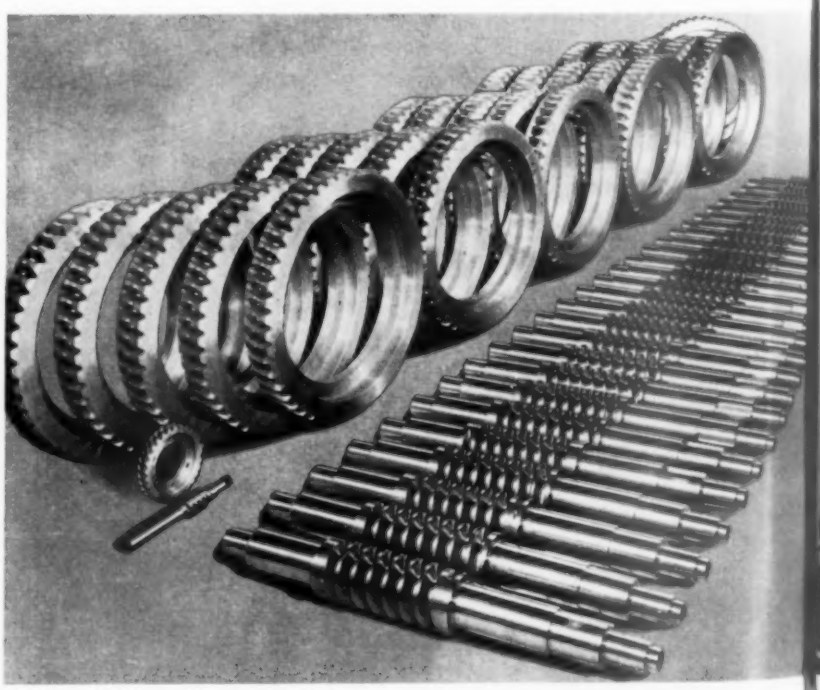


Fig. 7—Nickel alloyed bronze ring gears. Worm gears are of case-hardened nickel-alloyed steel

TABLE II—Common Constructional Bronzes Alloyed with Small Amounts of Nickel

No.	Type	Application	Chemical Composition						Tensile Strength	Yield Point	Elongation %	Brinell Hardness*
			Nickel	Copper	Tin	Lead	Zinc	Phos.				
1.	"G" Bronze (Gear Bronze) ASTM Spec. B143-46T	Construction Castings, Gears, etc.	...	88.00	10.00	none	2.00	0.05	40,000	.....	20	..
2.	"G" Bronze (Improved toughness and wear resistance)	Heavy load gears, cams, frames, etc.	1.00	87.00	10.00	0.50 max.	2.00	0.05	46,000	22,000	25	78
3.	"G" Bronze (Chill cast, toughness and wear resistance)	Heavy load, worm gear, chill cast	1.50	87.50	11.00	none	none	0.15	51,000	27,000	18	100
4.	Modified "G" Bronze	Fine grained	1.50	86.50	8.00	none	4.00	0.03	43,000	23,000	22	70
5.	Modified "G" Bronze (tough)	Fine grained	2.50	88.00	5.50	none	4.00	0.03	42,000	17,000	32	75
6.	"Ni-Vee" (Strong and tough)	General Purpose	5.00	88.00	5.00	none	2.00	0.05	47,000	22,000	45	85
7.	"Ni-Vee" (Strong and wear resistant) Heat Treated (a) (b)	Wear and Strength	5.00	88.00	5.00	none	2.00	0.05	80,000	55,000	10	150

(a) Heat Treatment—5 hours at 1400° F, oil quench
(b) Heat Treatment—5 to 10 hours at 550° F, air cool
* Brinell hardness obtained with 10 mm ball at 1000 Kg load

ments apply as well to the 5 per cent nickel composition shown as No. 6, (Table II). Fox[5] pointed out the depreciation in ductility which accompanied increasing amounts of lead in a 5 per cent nickel-5 per cent tin bronze. (Fig. 6).

Occasionally, these high-strength bronzes are desired for steam or hydraulic pressure applications. Their low lead contents, or the absence of lead, make them particularly attractive for steam or elevated temperature services.

Valves, pumps and steam specialties of the top grades are made of these tin bronzes which, because of their comparative purity, are less likely to suffer from deterioration at steam temperatures or from dezincification in corrosives.

For high pressure hydraulic applications where small amounts of lead are tolerable, these tin bronzes provide the foundryman with a metal that feeds well and has a much lesser tendency to shrink and develop porosity than do the aluminum, silicon or manganese bronzes. Furthermore, they pour cleanly with a corresponding advantage in freedom from dross. Illustrated at top of Fig. 9 is a steel mill "slipper," and at bottom is a gear blank with gating system attached. These pieces were poured in 84 Cu, 10 Sn, 3.5 Ni, 2.5 Pb bronze. In many pressure casting applications, the tin-nickel bronzes should be regarded as superior types which do not invade, but instead, enlarge the range of application of the pressure bronzes which will be described separately.

Melting — The melting and handling of nickel alloyed brass foundry (*Please turn to page* 192)

Fig. 8—Nickel alloyed tin bronze ring gears and nickel molybdenum case-hardened steel worm gears

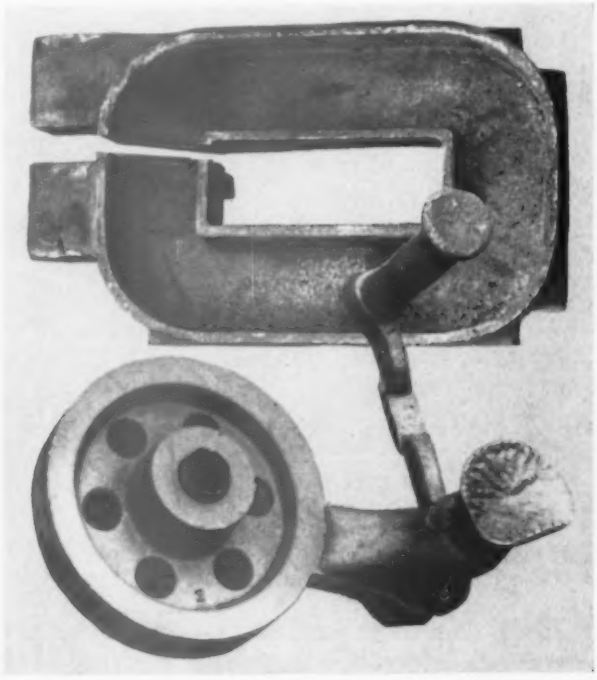
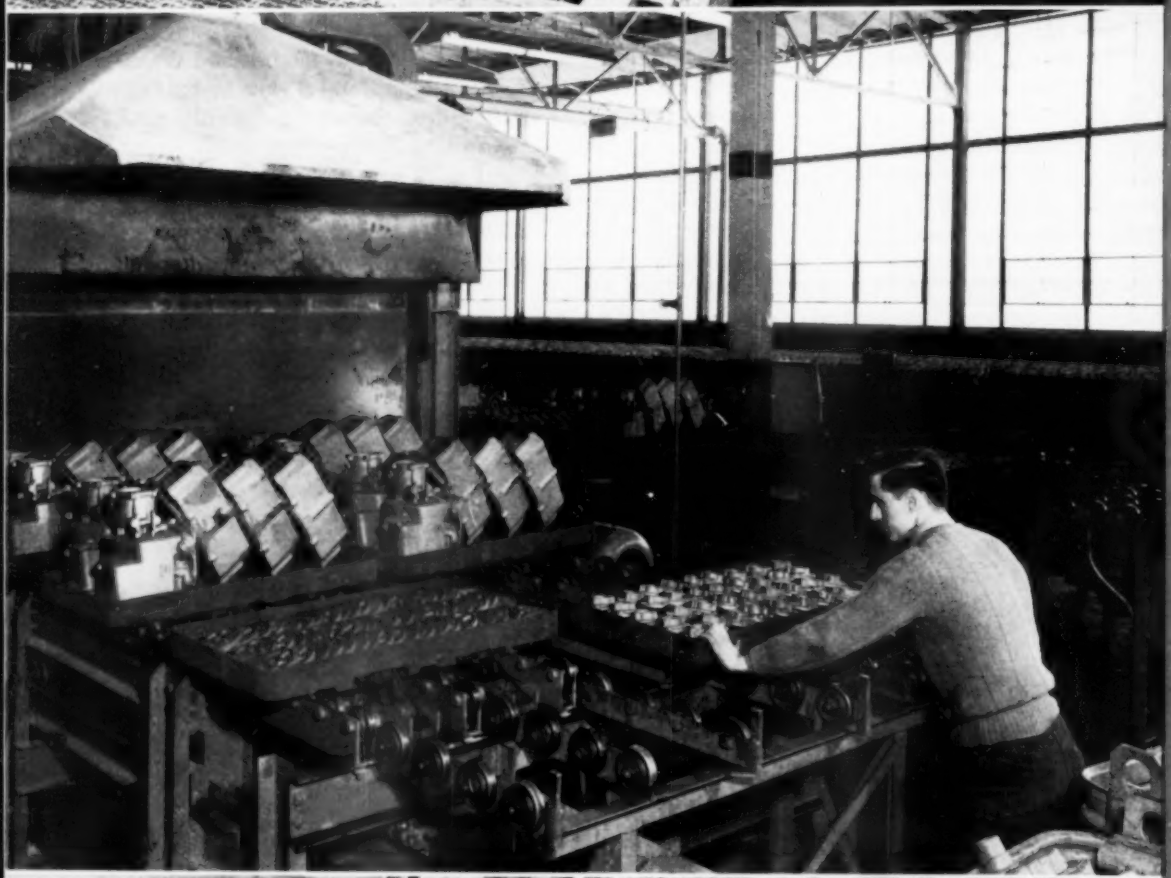
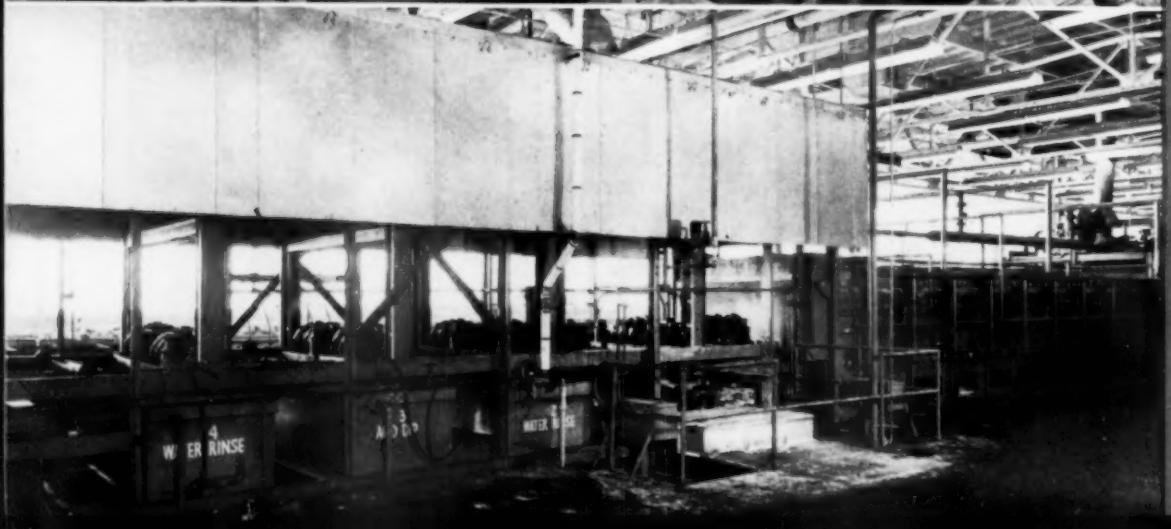


Fig. 9—At top is a steel mill "slipper." Gear blank, showing gating method, is shown at bottom





Salt

Fig. 1 (top)—Castings are loaded into trays carried by roller conveyor in preparation for normalizing — cleaning cycle

Fig. 2 (center)—Pushing trays from transfer car onto loading end of normalizing furnace conveyor

Fig. 3 (bottom) — Side view of unit showing the dip tanks at left and normalizing furnace at right

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Bath Cleaning

OF GRAY IRON CASTINGS

A high degree of cleanliness is demanded by Chevrolet of the castings making up its automatic transmission. The continuous process the company uses to clean and normalize these gray iron castings is detailed here

CLEANING all of the castings that go into the torque converter automatic transmission manufactured at Chevrolet-Cleveland Division of General Motors Corp., is accomplished by two men on each shift. The castings are normalized and cleaned in a continuous, automatic operation by conveying them through a furnace and a series of baths, including molten caustic, acid, water and oil.

The cleaning department comprises a comparatively small area—perhaps 5000 sq ft—in the brand-new 30-acre plant at Brookpark and Stumpf Rds., Parma, O., a Cleveland suburb. The Transmission Division has been in operation since November, 1949. Castings are brought by railroad car and truck directly into the building and are unloaded on a concrete apron level with the car floors and adjacent to the automatic normalizing-cleaning unit. They are shipped from the Chevrolet-Saginaw Gray Iron Foundry, Saginaw, Mich., and are shot-blast cleaned before shipment.

In preparation for normalizing and cleaning, the castings are loaded into cast alloy steel (35 Ni, 15 Cr) trays which have a grid bottom to permit maximum drainage of liquids in the various baths. The trays measure approximately 3½ ft long, 2 ft wide and 2 in. deep. During loading, the trays ride on a gravity roller conveyor located along one side of the normalizing-cleaning unit as shown in Fig. 1. When the trays have been filled, they are pulled off the end of the conveyor onto a transfer car which has a roller top level with the conveyor and the feeding end of the gas-fired normalizing furnace.

The transfer car holds two trays placed end to end. With the trays, it is pushed the few feet along a track to the feeding end of the oven, and the trays pushed onto the gravity roller conveyor which carries them through the furnace. Fig. 2 provides a view of the furnace conveyor loading operation.

The trays are pushed through the furnace along the roller conveyors by the arms shown resting against the side of the tray in the left foreground of Fig. 2. These arms are attached to a shuttle which operates on a four-minute cycle. At the beginning of the cycle, the doors at each end of the furnace open and the shuttle moves forward the desired distance, carrying a set of trays into the furnace and another set out. The shuttle then reverses, and the arms, being hinged, are pushed down as they travel back under the succeeding tray. Counterweights flip them up again into position for pushing another tray. The furnace doors are closed automatically. Castings remain in the normalizing furnace 1½ hours and are stress relieved at 1200°F.

The cleaning section of the unit, containing the tanks for the various baths, is shown in Fig. 4. A side view of the complete unit is shown in Fig. 3. It is approximately 80 ft. (*Please turn to page* 204)

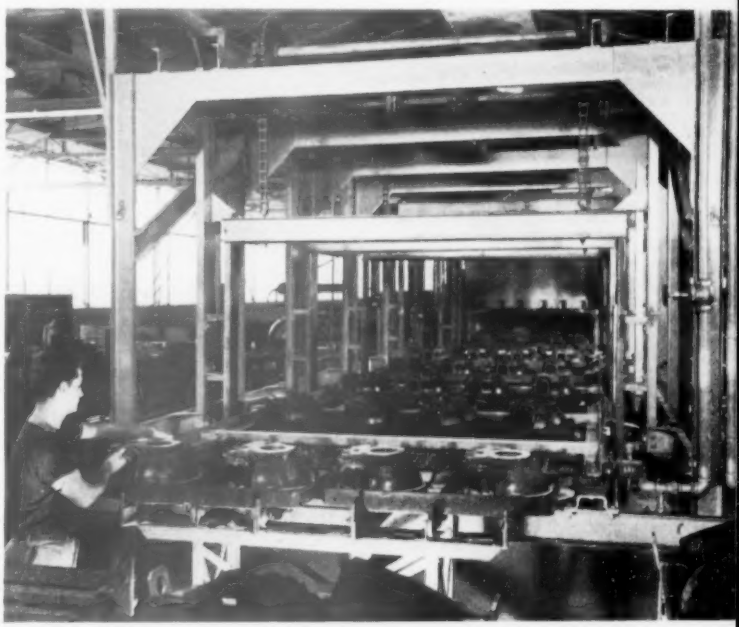

Fig. 4—Trays of castings being unloaded onto transfer car after completion of normalizing — cleaning operation

Plastic Bonded
Used in New

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New York Naval Shipyard
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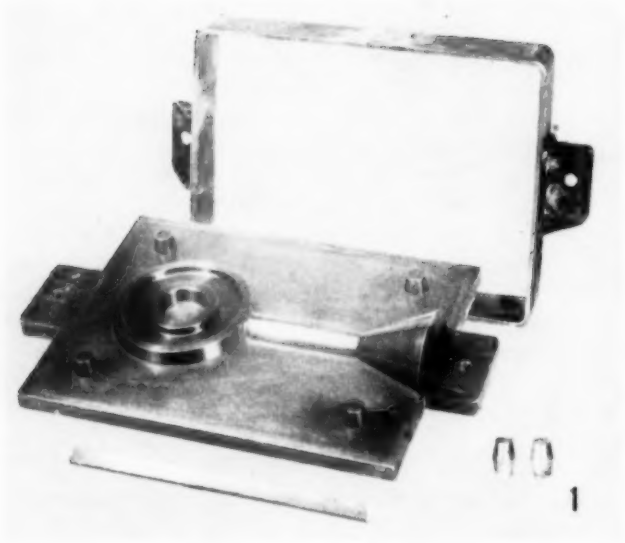


Fig. 1—Familiarization model pattern of a sheave-type wheel mounted on surface ground steel plate

THE stimulus of two relatively recent world conflicts upon the foundry industry, has been productive of wide technological advances in the manufacture of castings. This progress, exemplified by the development and application of metallurgical control, plant instrumentation, increased mechanization, more efficient melting equipment and practices, and improved gating and heading techniques has been reflected in increased product quality and manufacturing economy, and ultimately in a more favorable competitive status of the industry as a whole.

In the past decade designers have exhibited interest in a number of founding techniques which, coupled with a high degree of productivity at a reasonable manufacturing cost, gave promise of obtaining a casting product requiring a minimum of cleaning and machining operations. Some of these—like the plaster molding technique, and the several refinements of the "lost wax" investment casting method—are of ancient origin but, with modern engineering application and production equipment, have found a practical, if limited, application in many areas of industrial founding.

Recently a great deal of interest has been expressed by the foundry industry in this country in a relatively new molding process popularly referred to as the Croning or "C" process. Claims have been

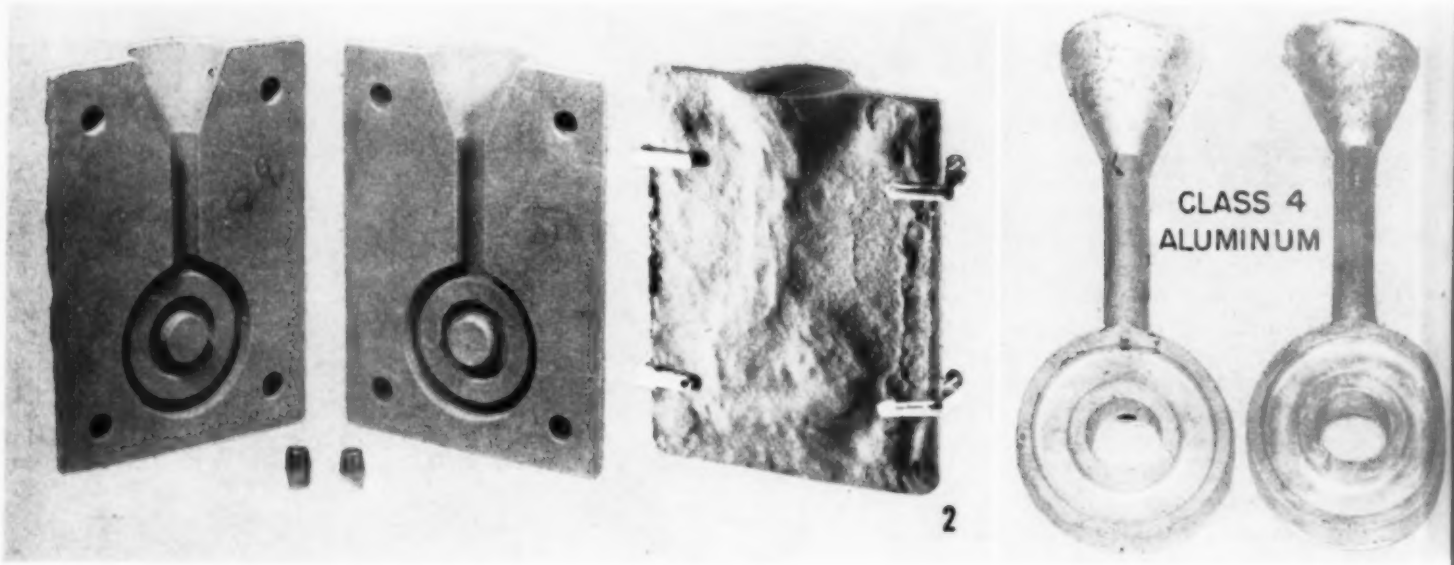


Fig. 2—In first tests a number of cured resin-sand mixture half molds were assembled with "C" clamps and poured in various alloys

Shell Molds
Casting Process

Discussing the basic fundamentals of the Croning or "C" process, the authors report on their investigation of the applicability of heat polymerized plastics as molding sand binders for casting nonferrous or ferrous metals. Their study also seeks to develop suitable founding procedures for possible utilization as molding media in Naval foundries

Fig. 5—Pattern plate and buffer frame are placed over investment holding box and (Fig. 6) rolled over to allow investment to lie against hot pattern

Fig. 4—Experimental pattern halves and plates with investment holding box

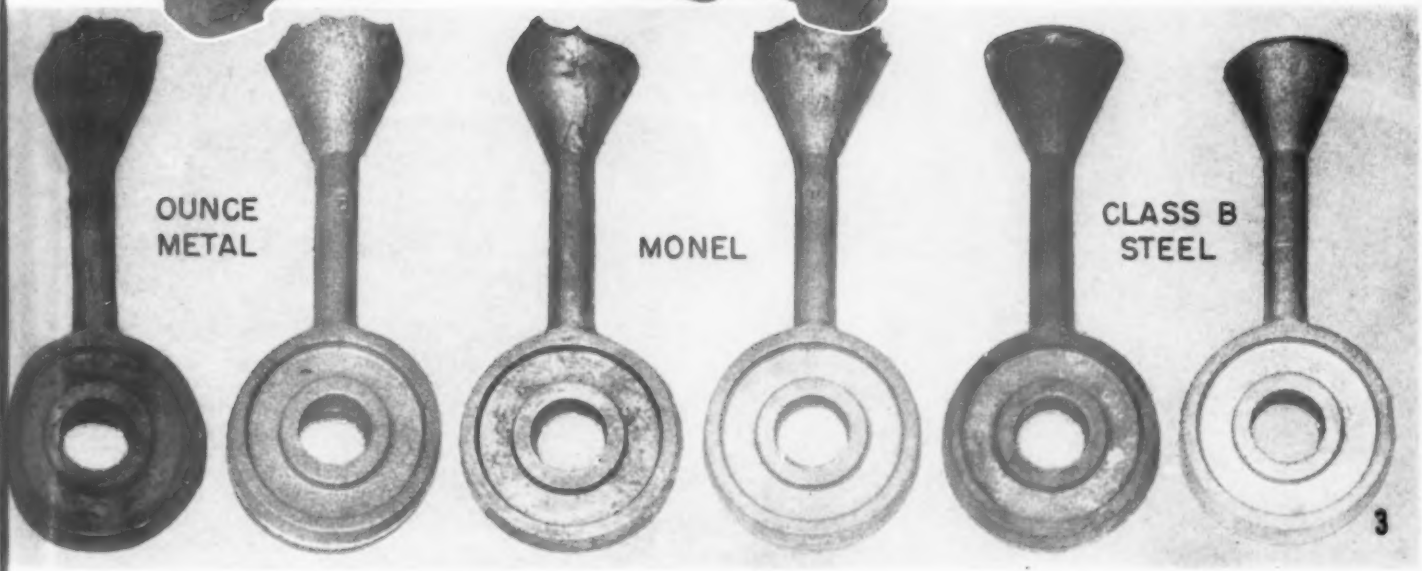


Fig. 3—Some first test castings of aluminum alloy, ounce metal, monel, and steel. As-cast and lightly shot-blasted pieces are shown

Fig. 7—Invested pattern is now ready for curing

Fig. 8—Cured mold shell is stripped from pattern

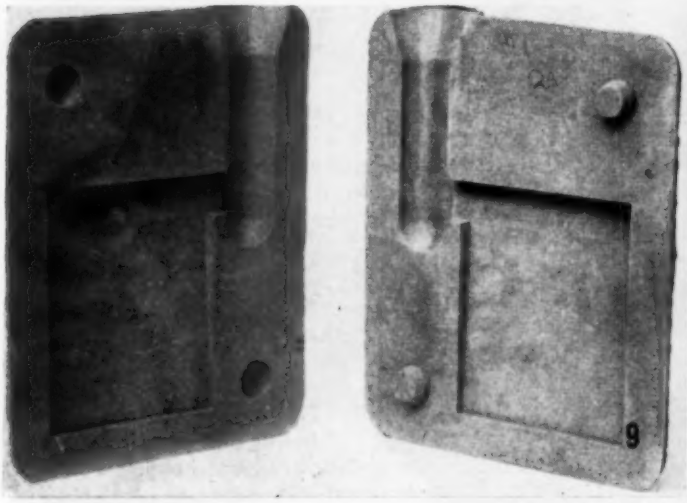


Fig. 9—A pair of cured mold halves, as stripped

Fig. 10—Assembled molds are backed up with shot

Fig. 11—Typical as-cast aluminum alloy plates

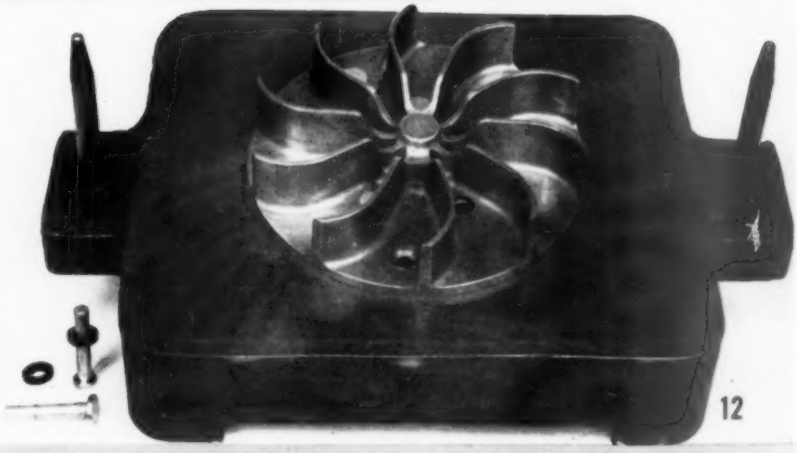
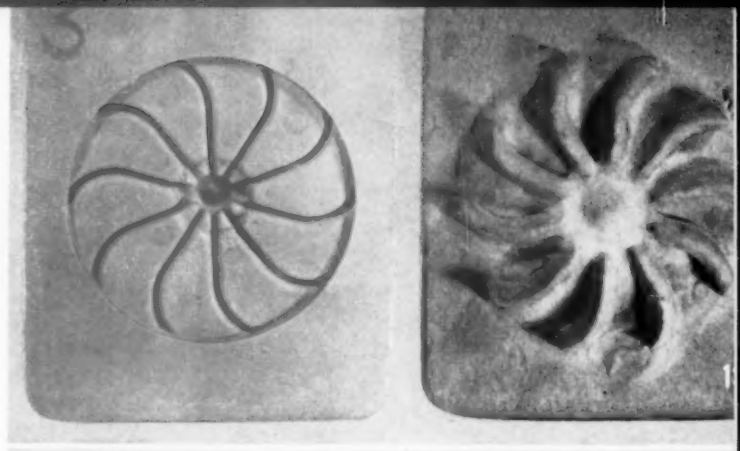


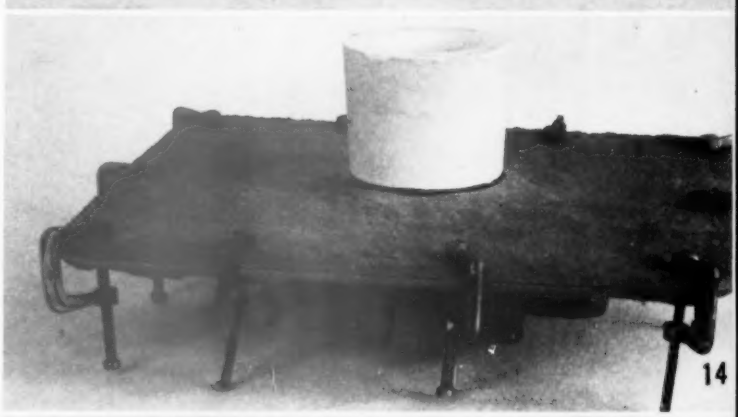
Fig. 12—Impeller drag pattern and plate assembly

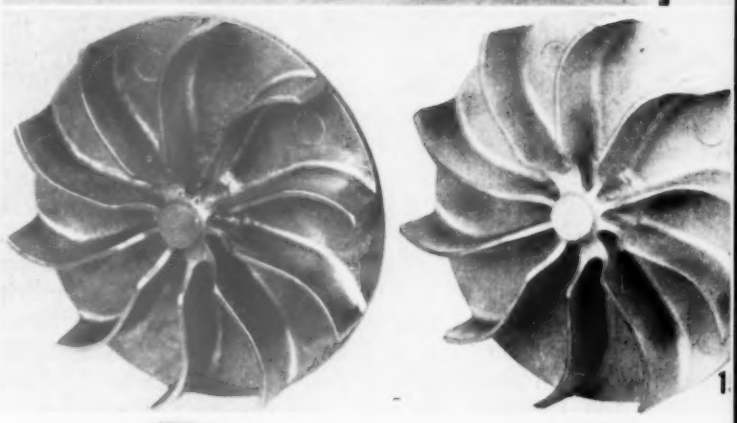
made by Croning[1] that the utilization of thermosetting plastics as sand binders by this technique has produced castings in aluminum and ferrous alloys to close dimensional tolerances and with good surface finish. In addition, a degree of productivity was claimed that compared favorably with and surpassed sand casting practice, with certain limitations on size and design. A further advantage noted was the elimination of skilled labor for moldmaking. Unfortunately until recently the technical and operating details of the method have been shrouded in a veil of secrecy so that the average foundrymen did not have a clear concept of what is involved. Hence this article will deal with the basic fundamentals of the method (the work being conducted at the laboratory with which the authors are associated) and the possibilities of the process.

The details of the method are rather sparingly described and sparsely illustrated in an O.T.S. report, FIAT No. 1168, prepared by William W. McCulloch[1] and dated May 30, 1947, which represents, so far as is known, the only descriptive literature concerning the process (THE FOUNDRY October, 1948). The method was utilized by Johannes Croning, primarily for the production of fittings cast in the light metals and ferrous alloys at the Hamburg plant of Croning and Co., during the recent war years. McCulloch reports a number of advantages claimed for the process, which include (a) complete stabilty for molds and cores with respect to volume change; (b) exceptional mold smoothness with high gas permeability; (c) an increase in mold production, for a given floor area and labor force, of four to six times; (d) elimination of skilled labor and expensive machinery; (e) practicability of storing molds for indefinitely long periods; and (f) production of castings to true dimensions with high detail and finish. McCulloch examined a number of castings manufactured at the Croning establishment and confirmed the last, although he furnished no detailed data as to the degree of precision the process was found capable of attaining.

Piwowarsky[2], who is familiar with the method indicated his belief that the "C" process was a sound and practical idea which with further development would doubtlessly yield positive and practical success. He pointed out that Croning had received considerable assistance from the German government during the war, and stated that the firm of Haller-Werke A. G. in Hamburg-Altona had established the process successfully for the manufacture of cores for the 8 cm hand grenade (hand grenade 31) reaching a capacity of 6000 components daily. He was of the opinion however that the process was not in widespread use commercially but that it is a sound idea which can be further developed into a very advantageous process







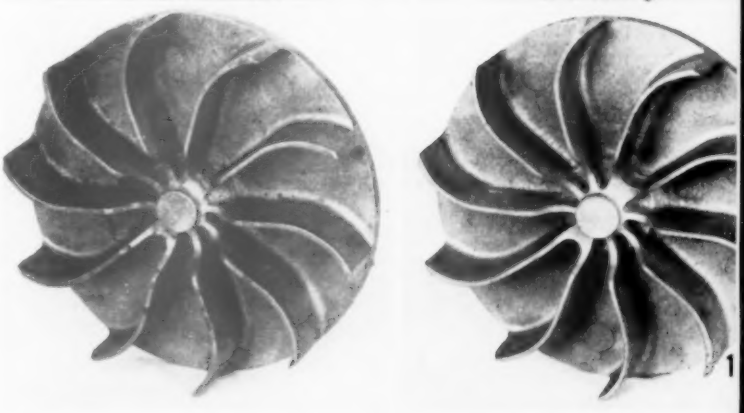


Fig. 13—Inside and outside of impeller drag mold

Fig. 14—Assembled impeller mold with gypsum riser

Fig. 15—Aluminum alloy and (Fig. 16) Navy gun metal impeller castings as cast (left) and vapor blasted

Fig. 17—Simple by-pass mold with core in place

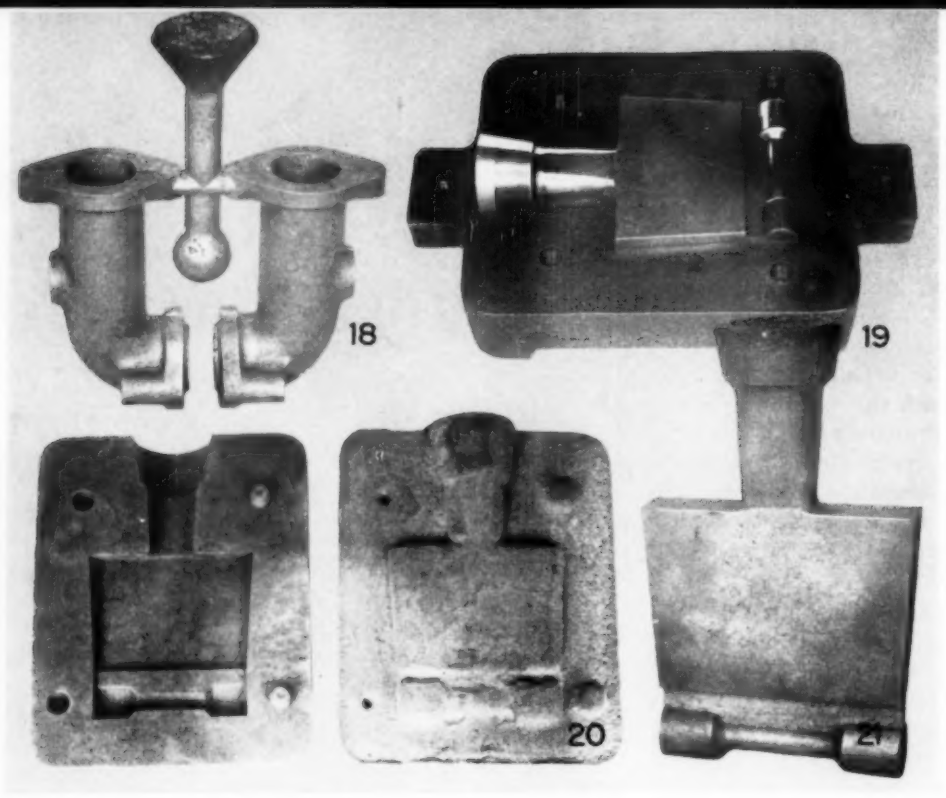


Fig. 18—Navy gun metal by-pass castings with gating

Fig. 19—Navy Fig. 10A bronze test bar pattern and plate

Fig. 20—Mold halves and (Fig. 21) as cast bronze test bar from Navy Fig. 10A master pattern

for the mass production of precision castings. He claimed that the high gas porosity (permeability) of the molds and cores is the secret of this process.

Basically, the method utilizes the thermo-setting properties of phenol-formaldehyde resins to provide a bond material for silica grains in the construction of a mold. While the use of urea and phenolic resins is by no means novel in the production of sand cores and molds, the production techniques described by McCulloch and which the authors have investigated are unusual in that neither temper liquids nor additional bond materials are employed. The molding medium consisted of a fine, washed silica sand of 90-100 AFS fineness, and a phenolic resin to which a 10 per cent addition of accelerator (hexamethylenetetramine) was added. A dry mixture of the sand and resin was prepared by a thorough mechanical blending; the approximate formula was given as 92 to 94 per cent silica sand, to 6-8 per cent plastic bond containing the accelerator.

The moldmaking operation described was essentially a mechanical one, and appeared to be neither involved nor difficult, requiring a few minutes of unskilled labor per finished mold. Metal half patterns and runners were used. They were mounted accurately on cast iron pattern plates in much the same manner as in long run molding machine practice. A set of beveled bosses on one plate, and a corresponding set of cavities machined into the reverse half, made for accurate registration in mold assembly. The pattern rigging was brought to a temperature of 360-400° F in a heat- (*Please turn to page* 206)

Fig. 22—Master by-pass pattern and plate. Stripping pin arrangement and core box also are shown

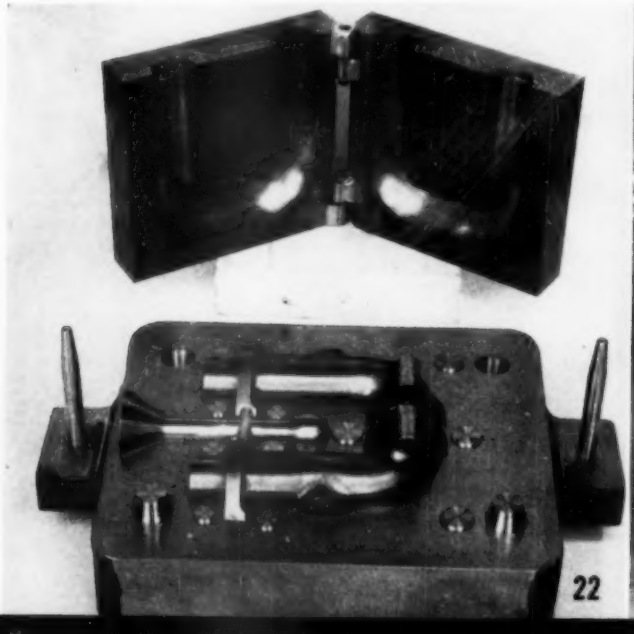
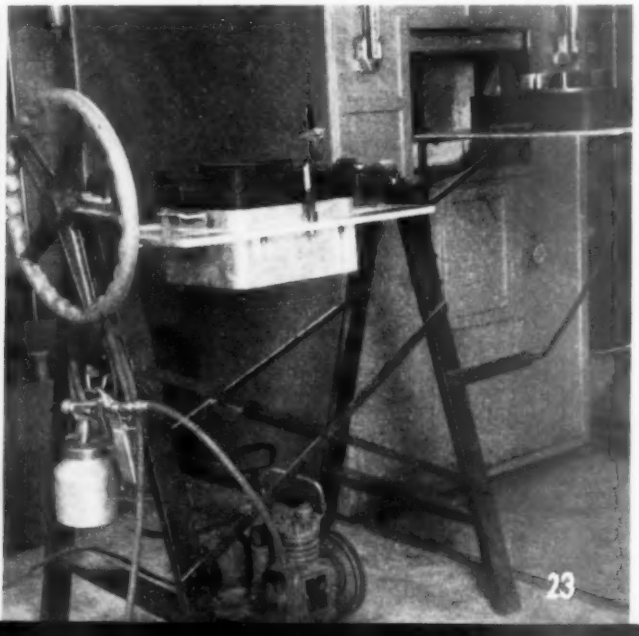


Fig. 23—Laboratory rollover machine for dumping investment material in holding box onto hot pattern



By HARRY A. SCHWARTZ
Manager of Research
National Malleable & Steel Castings Co.
Cleveland

Origin and Control of *Carbon in Ferrous Alloys*

This article is a chapter from the recent book, FOUNDRY SCIENCE, and is reproduced by permission of the Pitman Publishing Corp., New York. The work is directed to engineering students specializing in foundry practice, and to foundry engineers

THERE are many better reasons for giving space to the iron-carbon alloys than the author's special interest in that field. Ferrous castings constitute an enormous proportion of the world's foundry products. Their versatility, from soft steel to hard cast iron, is due in large measure to the great effect of carbon on the properties of the metal iron, coupled with the opportunity that the allotropic changes, that is, changes in the atomic arrangement, in the metal furnish for altering the form in which carbon exists in the alloy.

Source and concentration of carbon—A study of the iron-carbon system must begin with some attention to the iron-carbon-oxygen equilibriums, which often determine what the carbon content of a product will be. In the upper part of the blast furnace, iron ore (typically hematite, ferric oxide, Fe_2O_3) encounters a mixture of CO and CO_2 derived from the partial attainment of equilibrium of atmospheric oxygen with the carbon of coke. We have already touched on the essential reaction in considering the cupola in Chapter 10.

In either the cupola or the blast furnace, air strikes incandescent coke and burns the latter. Because of the excess of coke and the high temperature, equilibrium some distance up in the furnace finally requires a high proportion of CO. As the gases ascend through the stack and impart their heat to the descending charge as sensible heat and perhaps as heat of reaction, the equilibrium will shift to higher percentages of CO_2. However, below, say 500° C the reaction becomes so slow that the gases retain far more CO than would be expected.

The CO-CO_2 mixtures that are in equilibrium with Fe and FeO, FeO and Fe_3O_4, and Fe_3O_4 and Fe_2O_3 have been studied very extensively, especially by Schenck, and these equilibriums, which are independent of pressure, are shown in Fig. 1.

Actually the line marking the equilibriums of Fe and FeO marks the equilibrium of the compound FeO and Fe saturated with FeO, and in the zone above that line the oxygen content of iron decreases with CO_2 content. Shortly we shall see that iron will absorb carbon in this area (*Please turn to page* 135)

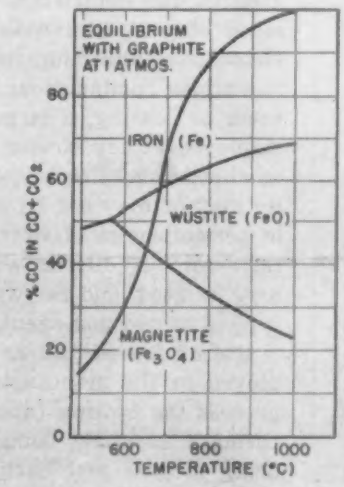


Fig. 1—Iron-oxygen and graphite-oxygen equilibrium (Approximately after Kelley's data)

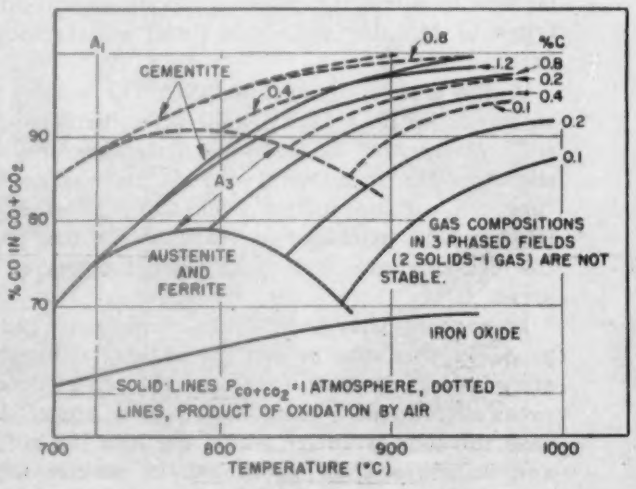


Fig. 2—Carbon-oxygen - austenite equilibriums (Approximately after Kelley's data)

QUESTIONS and

Castings to Meet Requirements

Q.—We are purchasing gray iron castings for high-grade instruments, and are having difficulty getting what we require. What we want is a sharply defined casting free of scale and sand so that we can set it up on a milling machine and end-mill it without destroying the latter as happened recently. In this case we did not order pre-age and stress relief, but now we do not know even if such instruction will be of help. Can you suggest a method of ordering from the foundry relative to heat treating, blasting, etc., as well as surface finish which will provide satisfactory castings?

A.—In our opinion there is no reason why you cannot secure satisfactory castings. If you include in your purchase requirements definite statements concerning machinability and surface finish, you should obtain the kind of castings you desire. For surface finish you could use the following, taken from ASTM Specifications for Gray Iron Castings (A48-49):

> Workmanship and Finish
>
> 13. The castings shall conform substantially to the dimensions on drawings furnished by the purchaser or to the dimensions predicated by the pattern supplied by the purchaser, if no drawing has been provided. The castings shall be free from injurious defects. Surfaces of the castings shall be free from burnt-on sand and shall be reasonably smooth. Runners, risers, fins, and other cast-on pieces shall be removed. In other respects the castings shall conform to whatever points may be especially agreed upon between manufacturer and purchaser.

Additionally you could specify abrasive blasting, if that is desired. Since the term "reasonably smooth," as indicated in the ASTM excerpt, might be interpreted differently by you and your supplier, it might be wise to submit sample castings of several different types to indicate what you deem satisfactory surfaces.

In the matter of machinability, the answer is not so easy. While a high tensile strength type of iron will not machine as easily as a medium or low tensile strength iron, with sturdy machine tools and tungsten carbide cutters even the highest strength irons can be machined at reasonable rates, provided the castings are free from chilled edges or other areas.

It appears that the breakage of your end mills probably was due to that condition, although possibly it was due to the presence of open-grain or soft areas surrounded by somewhat harder areas. In that case the tool or cutter would dig into the soft area, and be snapped off or broken in contact with the harder area. One method of ascertaining the presence of chilled edges or areas is the file test. If the file "bites" freely all over the surface, it is free from hard spots, but if it tends to "skid", watch out.

If high machinability of the castings is desired, you should specify heat treatment or, as it commonly is called, "annealing." In that operation the castings are heated to, and held at, an elevated temperature for a given period of time, and then cooled slowly in the furnace. The temperature varies according to composition, and may range from 1500 to 1800°F. With plain gray irons the temperature 1500 to 1600° F should serve and the time of holding is usually 1 hour per inch of the thickest section.

Such an operation adds to the casting cost, and to avoid it you might specify a brinell hardness range say on edges and corners where hard spots are likely to occur. The range would have to be based on experience obtained in your machine shop.

Data on Centrifugal Practice

Q.—We operate a centrifugal foundry in Italy using steel molds for making cylinder liners and would like to know if, in the United States, some other material perhaps with lesser life, but cheaper and more quickly produced, is employed for molds. We understand a thin refractory-graphite coating is used on the molds, and would like to know what refractory and the amount. Also what is used to make the coating adhere? Can we make such coating ourselves? Likewise, we have heard about use of dry ferrosilicon as a mold coating, but find that it is displaced by the metal stream. Does the ferrosilicon have to be ground finely, is a minimum speed of rotation required (our machines revolve on a horizontal axis at 1100 rpm), and can the mold be cylindrical or should it be cone-shaped?

A.—In answer to your first question, many molds used in the centrifugal process in this country are made of gray iron with or without addition of such elements as chromium, molybdenum, nickel, vanadium in various combinations. With reference to the mold wash or coating, a large variety of compositions are employed. They consist mainly of a refractory such as silica flour, fireclay, china clay (kaolinite). Graphite may or may not be used—generally it is employed in permanent mold work for aluminum castings. The refractory is diluted with water so that thin coats may be used, and the wash usually incorporates some type of suspension agent.

Use of ferrosilicon as a dry powder coating is employed in the manufacture of cast iron pipe. In one process the coating (about 0.0003-in. thick) is applied through a nozzle using compressed air, the nozzle being located just back of the metal pouring spout. The mold moves away from the spouts as pouring proceeds. Fineness of the ferrosilicon probably is

Answers

about 100-mesh. We understand that an earlier method developed on the Continent used ferrosilicon combined with a suitable adhesive which was sprayed on the mold face. Sodium silicate probably would serve.

Perhaps you employed too thick a coating of ferrosilicon; you will note the previous mention of 0.0003-in. thickness, which is about 0.01 mm. Probably in your short molds you could spray dry powdered ferrosilicon. The material should stay in place since it has been demonstrated that a thin layer of fine silica sand will not be displaced in a horizontally rotating mold for making steel pipes and tubes, and likewise a dry bentonite coating in a vertically rotating mold for producing bronze castings.

Aluminum Bronze Shows Stains

Q.—We have had trouble with aluminum bronze showing rust or stain marks when used for yacht fittings, and would like to know the cause. We are using ingot metal with up to 3 per cent iron.

A.—Rust stains on your aluminum bronze castings might be due to two causes. First is the possibility of uncombined particles of iron, but that would be more likely to occur if you were compounding the aluminum bronze from the raw materials than when using ingot. However, it might be well to examine the ingot to observe the presence of uncombined iron.

The other possibility is electrolytic action between aluminum bronze and some other metal or alloy in the presence of sea water which promotes preferential corrosion similar to dezincification in the case of brasses. For example, if the fittings are cleats coming in contact with galvanized hawsers, a galvanic couple would be formed with sea water as the electrolyte, and possibly cause preferential corrosion of the bronze.

Calsomine for Foundry Walls

Q.—Several years ago you answered a request for a material suitable for calsomining foundry walls which incorporated use of calcium carbide sludge, rye flour and salt. The formula was used by us with very excellent results. Unfortunately, we have lost or mislaid the article, and are wondering if you can supply the information.

A.—The calsomining composition you refer to was mentioned in an article on use of paint in the foundry by James L. Yates in the July, 1946 issue of THE FOUNDRY. Procedure is in steps in this order:

Mix 120 lb of calcium carbide residue with water to form a cream consistency. Mix 2½ lb of rye flour thoroughly with ½-gallon of cold water, and then thin with 2 gallons of boiling water. Dissolve 2½ lb common salt in 2½ gallons of hot water. Now mix the rye flour and salt solutions and then add the calcium carbide solution. Stir well until thoroughly mixed. Paint mixture then is ready for application. It weighs about 12 lb per gallon, and will cover about 225 sq ft of wood surface; 180 sq ft of brick or 270 sq ft of plaster surface.

Material has fire retarding qualities, and stays white for a long period of time. In fact, the author mentions an application made in 1939 still had excellent reflective power in 1945.

Melting Iron with Gas as Fuel

Q.—We are contemplating erecting a plant to manufacture centrifugally-cast soil pipe in a foreign country where coke is not available, but natural gas is in abundance, and use of the cupola is out of the question. Therefore, the melting aggregate has to be heated with gas. We will be glad to receive your advice on this.

A.—The only melting unit which could employ natural gas as a fuel to melt iron would be reverberatory type furnace with either a stationary or rotating hearth. Manufacturers of such furnaces are listed in the "Where-to-Buy Directory" on page 240 of this issue. Answer to your question of the suitable method cannot be given definitely, but the logical

GANGWAY!

By J. A. PATTERSON

"How did I happen to take up this work? . . . Well, one day I was pourin' tea at a social function and right then and there I decided . . ."

one would appear to be to use several of the smaller type, with melting and tapping staggered so that a continuous supply of metal would be available.

To be more explicit, assume that your metal requirements are 4000 lb of iron per hour. It is our understanding that a 2000-lb capacity small reverberatory will melt a heat in one hour; so that two such furnaces charged alternately on the hour and half-hour would produce a continuous supply of 4000 lb per hour. To be on the safe side it would be advisable to have a third furnace available as a spare to take over during relining or when some unforeseen melting complications develop.

Has Difficulty with Warping

Q.—We would like to have all the information possible on how to prevent warping and bending of gray iron castings in cooling.

A.—In overcoming warping or bending of castings a number of factors are involved. Primarily this condition is due to unequal cooling rates in various portions of the casting resulting in internal stresses. If the stresses are high enough, cracking or tearing will take place. Often the trouble is due to design of the part, particularly when thick and thin sections adjoin each other.

Correction usually is by rule of thumb. Sometimes the difficulty can be overcome by changing the gating system to provide progressive solidification from the point farthest from the gate to the gate. Decrease in pouring rate often helps since high pouring rates tend to cause steep temperature gradients in the casting. At times digging out some of the sand to expose parts of the casting to air cooling alleviates the warping. Use of chills to speed up the rate of cooling in the heavier sections also may provide some relief.

Last but not least is the use of stress-relief heat treatment whereby the castings are heated to around 1000° F and slowly cooled in the furnace. This procedure is used particularly when the warping, change in dimension, etc., occur after machining.

Metal Boils on Open Sand Bed

Q.—In our ordinary production schedule we make a considerable number of open sand molds for shop rigging. Some are plain plates and others—for example, flask ends and sides—have ribs and flanges on the lower side. As a general rule the metal lies quietly in the plain flat plates, but kicks more or less violently in the ribbed and flanged plates. We shall be interested in your opinion on this subject.

A.—Assuming that the sand is packed to a uniform density under both types of plates, the explanation of the different behavior is quite simple. Where the sand is too damp or packed too hard, the metal will kick and boil in all the plates, but where the sand is soft underneath and merely beaten down to a firm layer on top, the steam and gas under a plain plate escape readily. Where the passage is interrupted by ribs or flanges, the steam cannot escape readily. Some of the steam escapes upward through the metal to produce an action commonly described in the foundry as "boiling."

The obvious remedy is to provide artificial vent passages, either by driving a vent wire from the surface down to a coke bed, or by driving a vent wire horizontally under the sand bed from the outside. The same general rule applies to all molds where the joining of a vertical and horizontal plane in the pattern or casting encloses a body of sand and thus prevents ready egress to the steam and gas generated when the sand is raised to a high temperature. Preparation and manipulation of open-sand beds for plates, arbors and other types of castings was treated extensively in THE FOUNDRY many years ago. The same material slightly abridged was included later in a book *Tales From The Gangway,* published by the Penton Publishing Co., Cleveland, and copies of that may be secured from our book department.

Casting Liners Centrifugally

Q.—We would like to obtain information on the manufacture of centrifugal castings as follows: Should gray iron cylinder liners be annealed before machining, and if so at what temperature? Are the liners brought up to adequate brinell hardness by heat treatment? What is the normal brinell hardness of American-made liners? What is the chemical composition of centrifugally-cast cylinder liners? What kind of material is used for the molds? What material is used for coating the molds? What alloying agents are used? What is the usual microstructure?

A.—Your inquiry covers such a wide field that it cannot be answered briefly with any detail. For example, compositions cover a wide range depending upon the section thickness and the manufacturer's ideas. Generally, they contain nickel, chromium, molybdenum, etc. in various combinations. For example, one mixture shows 0.60 to 0.70 per cent Mo with 0.40 to 0.50 per cent Cr while another shows 1.80 to 2.20 per cent Ni and 0.55 to 0.75 per cent Cr. A large number of compositions are given in *Alloy Cast Iron Handbook* available through the book department of THE FOUNDRY, and we suggest that you obtain a copy.

For rapid machining the as-cast liners sometimes are annealed around 1000 to 1100° F—probably to relieve casting stresses. Following machining they are heat treated, quenched and drawn. Heat treating temperature will vary according to composition and may be in the range 1540 to 1560° F for 30 to 40 minutes (⅜-in. section). Quenched in still oil the brinell hardness will not be less than 512 or Rockwell C 52. Drawing is at 350 to 370° F for 2 hours. Structure usually is finely martensitic. Mold material may be steel or cast iron, and the mold face is coated with a thin wash of refractory such as silica flour, fireclay and sodium silicate, or china clay with sodium silicate.

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Industry BRIEFS

TRANSAMERICA Corp., 4 Columbus Ave., San Francisco, has proposed merger of its subsidiaries, Adel Precision Products Corp., Burbank, Calif., and Enterprise Engine & Foundry Co., San Francisco, with General Metals Corp., another subsidiary with plants in Los Angeles and Oakland, Calif., and Houston, Tex. Adel and Enterprise would be operated as divisions of General Metals.

* * *

Hapman Conveyors Inc., Detroit, and C. H. Dutton Co., Kalamazoo, Mich., have merged and will be known as Hapman-Dutton Co. with H. W. Hapman as president and general manager, and Robert J. Brown, vice president, assistant general manager and treasurer. Principal sales office of Hapman Conveyors Division will be at 19209 West Davison Ave., Detroit 23, and that of Dutton Boiler Division at 630 Gibson St., Kalamazoo 6.

* * *

Casting Service Corp., 300 Philadelphia St., La Porte, Ind., has acquired Bridgman Castings Inc., Mathieu Ave., Bridgman, Mich., which discontinued operations in October. Addition of the second plant will provide a means for manufacture of larger gray iron castings, according to William F. Lang, president of Casting Service Corp.

* * *

Allis-Chalmers Mfg. Co., Box 512, Milwaukee 1, has made a nonexclusive agreement with Picker X-Ray Corp., New York, covering sale and service of Allis-Chalmers' betatrons for medical and industrial applications. The Picker firm will handle promotion, installation and servicing of the unit.

* * *

Newaygo Engineering Co., Newaygo, Mich., has appointed Russo Foundry Equipment Co., 7315 Holly St., Oakland 3, Calif., distributor for northern California, Washington, Oregon, Nevada, Utah, Idaho, and Vancouver, B. C.

* * *

Kirk & Blum Mfg. Co., 2808 Spring Grove Ave., Cincinnati 25, has acquired the plant and property of Cincinnati Planer Co., 3120 Forrer St., in suburban Oakley. Facilities of the planer company include over 100,000 sq ft of manufacturing and storage space, fronted by a two-story, air conditioned office and engineering building. Kirk & Blum plans occupancy at the end of the year when its five warehousing and manufacturing facilities will be consolidated in the plant.

* * *

C. D. Palmer Brass & Copper Co. filed articles of incorporation at Albany, N. Y., in June. Directors are Louis Fortgang, 1288 Ocean Parkway, Brooklyn, N. Y.; Carmela Albino, 20 Highlawn Ave., Brooklyn, and Mae Bauman, 296 Avenue P, Brooklyn.

* * *

Burgess-Parr Co., foot of Exchange St., Freeport, Ill., has changed its name to Illium Corp. because of close association of the company with its principal product, Illium, a corrosion resistant alloy.

* * *

Sonith Industries Inc., 50 Shelby St., Indianapolis, iron and brass foundry, has been purchased by Food Machinery & Chemical Corp., and is under the supervision and management of Mechanical Foundries Division, Los Angeles. THE FOUNDRY, July, 1950, incorrectly reported that Sonith had been sold to Peerless Pump Division. Sonith Industries Inc. is a wholly owned subsidiary of Food Machinery & Chemical Corp. and will continue its operation as Sonith Industries Inc.

NEW FURNACE: Electric Steel Foundry, 2141 Northwest 25th Ave., Portland, Oreg., has added two electric furnaces to its melting equipment. One of the furnaces is shown above. This is the initial step in a plant-wide program designed to increase efficiency and production capacity of all departments

* * *

Western Sealant of Western New York Inc., Buffalo, has been incorporated in New York, with capital stock listed at $25,000, to operate a general foundry business. Directors are Norman B. Newcomb, Robert L. Strebel and Ruth L. Melison, all of Liberty Bank Building, Buffalo.

* * *

Pettibone Mulliken Corp., 4700 West Division St., Chicago, has acquired Hammermills Inc., St. Louis, manufacturer of hammer mills for mining and other operations, as a wholly owned subsidiary. Hammermills Inc. headquarters have been moved to the Chicago address.

* * *

Chicago Eye Shield Co., Chicago, has appointed Guardian Safety Equipment Co., 4215 First Ave. N., Birmingham, distributor for Alabama and Mississippi. Howard Freed, formerly with Williams & Co., Cleveland, will head the new distributorship.

* * *

Lebanon Steel Foundry, First Ave. & Lehman St., Lebanon, Pa., has made licensing agreements with Timken Roller Bearing Co., Canton, O., to produce and sell the latter's patented heat-resistant alloy.

* * *

Catalin Corp. of America, 1 Park Ave., New York, and Fords, N. J., has started producing core baking resins and other plastic compounds in its new plant at Calumet City, Ill.

* * *

Robins Conveyors Division, Hewitt-Robins Inc., New York, has moved its Cleveland office from 215 Rockefeller Bldg. to 8905 Lake Ave.

* * *

Ammen's Foundry Inc., filed articles of incorporation at Baton Rouge, La., in June. Capital stock was listed at $50,000.

* * *

Foundry building of Blair Aluminum Furniture Co., Marietta, Ga., was destroyed by fire June 7.

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Portland 14, Oregon

MEN of Industry

ERNEST M. KNAPP has been named president, Ferro Machine & Foundry Inc., Cleveland, succeeding **John M. Price,** new chairman of the board. Mr. Knapp, who received degrees from Miami University and Kenyon College, joined the company in 1933, where he has served as cashier and chief accountant, assistant treasurer, and more recently as treasurer and assistant secretary. **Rex J. Myers,** formerly assistant foundry superintendent, has been appointed vice president in charge of operations, succeeding his father, **Henry B. Myers,** who will remain as consultant and vice president. **Donald L. Heine,** formerly chief accountant and comptroller, has been named treasurer and assistant secretary, and **Ralph H. Weir** continues as vice president-secretary.

♦ ♦ ♦

Edward P. Buchanan has been appointed manager of the Pig Iron Division, Pittsburgh Coke & Chemical Co., Pittsburgh. Mr. Buchanan has been in the company's sales organization for 12 years except for 2½ years during the war when he was assistant to the chief of the Pig Iron Section, War Production Board, engaged in allocation of pig iron to the foundry and steel industries. Prior to joining Pittsburgh Coke & Chemical Co. he was associated with Pittsburgh Steel Co., Pittsburgh, for 5 years. Mr. Buchanan has served for several years as secretary-treasurer of the Pittsburgh Foundrymen's Association.

Lawrence J. Kline has been appointed general manager of the Automatic Transportation Co. Division, Yale & Towne Mfg. Co., Chicago, succeeding **Elmer F. Twyman,** who has been elected vice president in charge of the Philadelphia Division. Mr. Kline, who attended University of Nebraska, joined Automatic Transportation Co. Division recently as sales manager, following 31 years with Mercury Mfg. Co., Chicago, where he became executive vice president.

♦ ♦ ♦

T. S. Roderick has been appointed general manager, Non-Ferrous Permanent-Mold Inc., with headquarters at the company's offices in Mansfield, O., where he will be engaged in sales and operational planning. Mr. Roderick, a graduate of the U. S. Naval Academy in 1941, recently resigned from the service with rank of lieutenant commander.

♦ ♦ ♦

Herbert F. Miller, has moved his offices from Rockford, Ill., to 718 West Second St., Marion, Ind., where he will continue as consultant in foundry operations and engineering. Mr. Miller was graduated from Harvard University in 1908, where he specialized in metallurgy. During the war he was foundry superintendent at the defense plant of Continental Foundry & Machine Co., East Chicago, Ind. Prior to that he was associated with the Pittsburgh Works of American Steel Foundries; General Steel Castings Corp., Eddystone, Pa.; Central Specialty Co., Ypsilanti, Mich.; Gunite Foundries, Rockford, Ill., and Marion Malleable Iron Works, Marion, Ind.

♦ ♦ ♦

David T. Woodhouse has been appointed manager of product development and methods, the Cleveland Chain & Mfg. Co., Cleveland. Mr. Woodhouse, a graduate of New Hampshire University, formerly was affiliated with Woodhouse Chain Works, Trenton, N. J., founded by his grandfather in 1884. In 1947 the company was acquired by the Round Associate Chain Companies which also operate Cleveland Chain & Mfg. Co.

♦ ♦ ♦

G. G. Coolidge, formerly vice president in charge of sales, Harbison-Walker Refractories Co., Pittsburgh, has been appointed executive assistant to the president. Mr. Coolidge, who has been a vice president and director of the company since 1933, is also a director of Blaw-Knox Co., Pittsburgh.

♦ ♦ ♦

William A. Meiter has been named central sales manager, Worthington Pump & Machinery Corp., Harrison, N. J., to direct sales of Buffalo, Detroit, Cleveland, Cincinnati and Pittsburgh offices, with headquarters in Detroit. Mr. Meiter joined the company in 1927 following graduation from Ohio State University. He was named sales engineer in the Cleve-

(Continued on page 106)

ERNEST M. KNAPP

DONALD L. HEINE

REX J. MYERS

EDWARD P. BUCHANAN

OVER a period of 68 years Woodward has jealously maintained its reputation for producing iron to meet exacting specifications. This quality of uniformity is not a happy accident. It is a combination of the best equipment and experienced "know-how."

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MEN of Industry

(*Continued from page* 104)

land district sales office and in 1938 became manager of the Buffalo office. **John W. Stovall** succeeds him there as manager. Mr. Stovall attended Carnegie Institute of Technology and became an estimator in the Pittsburgh district sales office in 1929, sales engineer there in 1932 and since 1942 has been sales engineer in the Rochester, N. Y., sales office.

♦ ♦ ♦

Howard E. Edsall, for the past 3 years general superintendent, Sorel Steel Foundries Ltd., Sorel, Quebec, has been appointed service engineer, Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa. Mr. Edsall was graduated from Ohio Northern University in 1940 with a degree in mechanical engineering. While a student at the university he worked during vacations in various foundry departments of Marion Power Shovel Co., Marion, O. Following graduation he became assistant superintendent of that company's foundry division and from 1942 to 1947 was superintendent.

♦ ♦ ♦

F. L. Roewer has been appointed sales manager, Abrasive Alloy Castings Co., Bridgeboro, N. J., producer of nickel alloy cast irons for special duty purposes. For the past 15 years Mr. Roewer has been associated with the International Nickel Co., New York, in promotion and sales work and spent 4 years in the Army Air Force during the war.

♦ ♦ ♦

William C. Wick has been appointed foundry superintendent, Rolle Mfg. Co., Lansdale, Pa., producer of commercial nonferrous castings. In 1939 Mr. Wick joined Whiting Corp., Harvey, Ill., as an apprentice, and from 1940-44 was a cupola operator and foundry technician, Armour Research Foundation, Chicago. From 1944 to 1946 he served at the Naval Research Laboratory, Washington, where he participated in development of insulating riser sleeves and pads for bronze castings. Upon his release by the Navy in 1946 he returned to Armour Research Foundation where he was associate foundry metallurgist the last 4 years.

♦ ♦ ♦

E. M. Platts, since 1947 sales vice president, Joy Mfg. Co., Pittsburgh, has been named executive vice president, succeeding the late Arthur S. Knoisen. Mr. Platts became associated with the company in 1945 when it acquired La-Del Conveyor & Mfg. Co., New Philadelphia, O., of which he was vice president. He became vice president in charge of coal equipment sales for Joy Mfg. Co. at that time and in 1947 was elected to the board of directors and placed in charge of all sales.

♦ ♦ ♦

W. V. Blake has been named vice president-engineering, and **R. O. Lane,** vice president-sales engineering, Macklin Co., Jackson, Mich., producer of grinding wheels and abrasives. Mr. Blake, a graduate of Ohio State University, joined the company in 1930 and has had charge of the engineering department since that time. Mr. Lane, also an Ohio State University graduate, received a master's degree in ceramics from Massachusetts Institute of Technology in 1936, when he joined Macklin Co. He has worked in the sales manufacturing and sales engineering departments since that time. **Malcolm T. Hunt,** formerly assistant sales manager, was appointed sales manager of the company, succeeding **B. F. McIntyre** who retired because of poor health. Mr. Hunt joined the company in 1928. Mr. McIntyre had been vice president since 1927, when the company was organized. He was in charge of sales in the Detroit district and later the Chicago area. In 1936 he went to Jackson and became sales manager. He remains connected with the company in an advisory capacity.

♦ ♦ ♦

Donald L. Harwood, formerly assistant purchasing agent, has been appointed purchasing agent, Fairbanks, Morse & Co., Chicago. Mr. Harwood joined the Three Rivers, Mich., plant of the company in 1926, and later served at the Beloit, Wis., works and Chicago headquarters office in purchasing and production capacities.

♦ ♦ ♦

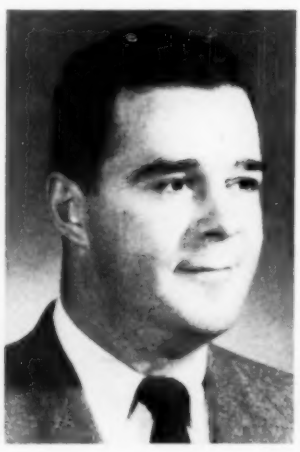
Howard J. Sanders, chemical engineer, Calco Chemical Division, American Cyanamid Co., New York, has been awarded first prize of $250 by Cooper Alloy Foundry Co., Hillside, N. J., in its nationwide contest concerning applications for cast stainless steel in the chemical industry. Second and third prizes of $150 and $100 were awarded, respectively, to **John D. Altstetter,** metallurgical engineering student, Ohio State University, and **Max J. Sorensen,** Villanova College.

♦ ♦ ♦

Dr. A. J. Weith Jr. and **J. F. Allen** have been appointed technical service representatives of the synthetic organic chemicals department, Industrial Chemicals Division, American Cyanamid Co., New York. Dr. Weith, a graduate of Duke University, has worked in the Stamford, Conn., research laboratories since he joined the company in 1947. During the

(*Concluded on page* 109)

HOWARD E. EDSALL



F. L. ROEWER

WILLIAM C. WICK

E. M. PLATTS

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Top Performance Consistently Duplicated

MEN of Industry

(*Concluded from page* 106)

war he was associated with the Office of Scientific Research and Development. Mr. Allen, who was graduated from Yale University, spent 4 years with Devoe & Raynolds Co., New York, following 4 years in the Navy. He joined Cyanamid this year.

♦ ♦ ♦

C. J. Yaeger has been appointed district sales manager and sales engineer in the Texas territory, A. P. Green Fire Brick Co., Mexico, Mo., with headquarters in Houston, Tex. Mr. Yaeger, who has had 12 years of experience in sale and application of refractory products, has been sales office manager of the company's general offices in Mexico, Mo., for the past 3 years.

♦ ♦ ♦

Edwin A. Swensson has been appointed sales engineer, Carl Mayer Corp., Cleveland, in charge of foundry core oven sales in Michigan, Indiana, and Toledo, O., with headquarters at 2970 West Grand Blvd., Detroit. Mr. Swensson, who studied at Illinois Institute of Technology, has had experience as foundry consultant and industrial conveyor engineer. For the past 8 years he was associated with National Engineering Co., Chicago, recently as sales and service engineer in the Detroit area.

♦ ♦ ♦

Donald Dingwall has been appointed Chicago representative, the Wellman Bronze & Aluminum Co., Cleveland, to handle sale of magnesium, aluminum and bronze, permanent mold and sand castings, wood and metal patterns. Following graduation from Northwestern University in 1935, Mr. Dingwall was sales representative for Novelty Foundry & Iron Works Inc., Sterling, Ill. He served in the Navy from 1942 to 1946, and upon release from service was instrumental in forming the American Matchplate Co., Milwaukee. When that company was sold in 1948, Mr. Dingwall returned to Chicago as a manufacturers' representative, selling gray iron castings. His office is Room 201, 100 North LaSalle St., Chicago.

♦ ♦ ♦

Lee C. Wilson has been appointed resident manager of a branch at 716 Washington, St., Reading, Pa., recently opened by Bearings Inc., Philadelphia. Mr. Wilson is well known in the foundry industry and recently served as a consultant for the National Security Resources Board, Production Division, Manufacturing Group, where he was engaged in a special survey of the foundry equipment and supplies industries. He is a past president of the American Foundrymen's Society and has been active in the technical work of the Steel Founders Society of America.

♦ ♦ ♦

W. Earle Sumway has been appointed manager of the sales engineering department, Abrasive Division, Norton Co., Worcester, Mass. **Fred L. Curtis** has been named sales manager of its western region.

♦ ♦ ♦

Albert E. Bickell has been appointed assistant district sales manager of the Pittsburgh office, General Refractories Co., Philadelphia. Mr. Bickell was graduated from Pennsylvania State College and joined the Buffalo sales office of the company in 1937. He was transferred to the Philadelphia office 3 years ago. **George L. Peck,** who has been in the Pittsburgh sales office since 1948, replaces Mr. Bickell in Philadelphia.

♦ ♦ ♦

Glenn A. Oman has been appointed director of the Co-operative Training Division, International Correspondence Schools, Scranton, Pa. Mr. Oman will continue to direct the industrial service department which prepares and administers training programs for companies and industries requiring specially written courses.

♦ ♦ ♦

Frank L. Blodgett has been named sales manager of the hard surfacing division, Alloy Rods Co., with headquarters at the main office and plant, York, Pa. Mr. Blodgett will be responsible for distribution of hard facing alloy and tool steel electrodes manufactured by the company.

♦ ♦ ♦

William S. Wood, vice president, Beloit Iron Works, Beloit, Wis., has been elected president of the Wisconsin Manufacturers' Association, succeeding **L. D. Harkrider.** Mr. Wood joined the company in 1929, following a career in the Army.

♦ ♦ ♦

Walter E. George, in charge of pattern control, Hunt-Spiller Mfg. Corp., Boston, was honored recently by company officials and fellow employees in observance of 30 years with the company. Mr. George began as a pattern storage clerk.

♦ ♦ ♦

Thomas Whelan Jr. has been appointed district sales manager of the Houston, Tex., office, Patterson Foundry & Machine Co., East Liverpool, O. Mr. Whelan was formerly associated with C. F. Braun & Co., Alhambra, Calif., in the design and sale of processing equipment.

♦ ♦ ♦

O. Ivan Lee has been appointed chief spectrographer in the main laboratories of United States Testing Co., Hoboken, N. J.

C. J. YAEGER

EDWIN A. SWENSSON

DONALD DINGWALL

Malleable Founders' Society

HOLDS ANNUAL MEETING

NUMEROUS accomplishments during the past year in its varied activities were reviewed by the Malleable Founders' Society at its annual meeting held at the Homestead, Hot Springs, Va., June 22-23. Looking to the future, the Society laid plans for the promotion of better product quality, production techniques, cost accounting practice, sales, and improved safety in plant operations.

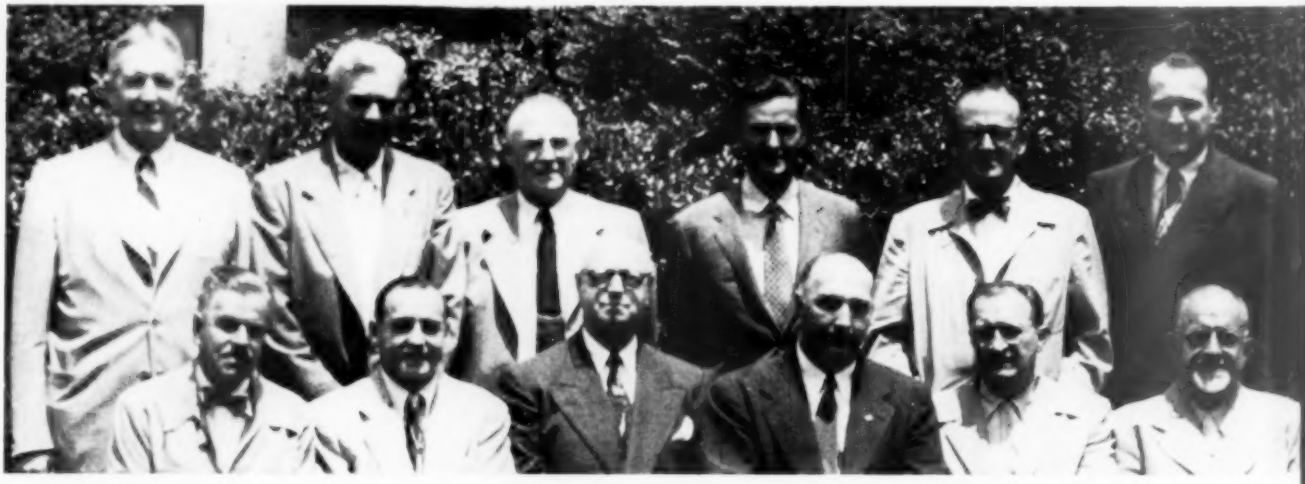
At the annual election of officers, Ralph T. Rycroft, president, Kencroft Malleable Co. Inc., Buffalo, was named president to succeed James H. Smith, general manager, Central Foundry Div., General Motors Corp., Saginaw, Mich. The new vice president is Cal C. Chambers, president, Texas Foundries Inc., Lufkin, Tex. Newly elected directors are: W. V. Tiscornia, executive vice president, Auto Specialties Mfg. Co., St. Joseph, Michigan; Max Traum, president, Newark Malleable Iron Works, Newark, N. J.; C. M. Lewis, president, Badger Malleable & Mfg. Co., South Milwaukee, Wis., and Mr. Chambers. Lowell D. Ryan continues as managing director and secretary, with James H. Lansing entering his fifteenth year as technical and research director of the society.

By WILLIAM G. GUDE
Managing Editor
THE FOUNDRY

Special honor was paid by the society to Frank O. Parker, vice president, Dayton Mallable Iron Co., Dayton, O. by presentation of the 1950 McCrea medal. This annual award in honor of the memory of the late president of National Malleable and Steel Castings Co., Cleveland, was made at the annual banquet to Mr. Parker by Ralph N. Cole, president, Canton Malleable Iron Co., Canton, O. The award to Mr. Parker recognized his outstanding service to the malleable castings industry and cited him for his work in connection with the production of the society's motion picture, "This Moving World." Mr. Parker was chairman of the committee in charge of the film production. A former president of the Malleable Founders' Society and for many years a member of its board of directors, Mr. Parker has been associated with the industry since 1923 when he became an inspector in the employ of the society. Since that time he has been identified with the industry in various executive capacities, principally in sales. He has been connected with Dayton Malleable Iron Co. as vice president since 1946.

At the opening general session, James H. Smith, retiring president, reviewed the year's activities of the society's committees and staff. Pointing to the fact that production of malleable iron castings this year may reach 800,000 tons or more, an increase of 100,000 tons over that of 1949, he indicated that the industry's goal of 1,000,000 tons could be reached. Mr. Smith urged that industry members give increased attention to safety activities, and stated that this subject would be stressed during the coming year.

Activities of the past year by the society's various standing committees were reported by: Cost Accounting, by Ralph N. Cole, Canton Malleable Iron Co.; Educational, by Lowell D. Ryan for Chairman R. W. Crannell, Lehigh Foundries Inc.; Finance, by W. H. Moriarty, National Malleable & Steel Castings Co.; Market Development, by William J. MacNeill, Dayton Malleable Iron Co., Dayton, O.; Membership, by John T. Llewellyn II, Chicago Malleable Castings Co., for Chairman F. E. Clark, Wm. E. Pratt Mfg. Co.; Plant Operations, by T. T. Lloyd, Albion Malleable Iron Co.; Research and Product Improvement, by C. A. Gutenkunst Jr., Milwaukee



Officers and directors who attended the meeting are, seated, left to right: C. M. Lewis, Badger Malleable & Mfg. Co., South Milwaukee, Wis.; Max Traum, Newark Malleable Iron Works, Newark, N. J.; Cal C. Chambers, Texas Foundries Inc., Lufkin, Tex.; R. T. Rycroft Sr., Kencroft Malleable Co., Buffalo; J. A. Wagner, Wagner Malleable Iron Co., Decatur, Ill.; and W. V. Tiscornia, Auto Specialties Mfg. Co., St. Joseph, Mich. Standing, left to right: James H. Lansing, Malleable Founders' Society; F. O. Parker, Dayton Malleable Iron Co., Dayton, O.; H. P. Blumenauer Sr., Albany Castings Co., Voorheesville, N. Y.; J. T. Llewellyn II, Chicago Malleable Castings Co., Chicago; J. H. Smith, Central Foundry Division, General Motors Corp., Saginaw, Mich.; and Lowell D. Ryan, Malleable Founders' Society

Malleable & Gray Iron Works, for Chairman George E. Bean, Eastern Malleable Iron Co.; Technical Council, by W. A. Kennedy, Columbia Malleable Castings Corp.

In reporting the completion of the society's new cost manual, Mr. Cole recommended wide-spread use of the principles set forth. A busy year for the Market Development Committee was reported by Mr. MacNeill. Activities included showing of the society's motion picture, reissue of an engineering sales data file and *Malleable Iron Facts*, and the holding of the first Market Development conference at Evanston, Ill. Mr. MacNeill said that a second conference is being planned for the coming year. Showings the past year of "This Moving World" were made before an estimated audience of more than 200,000 persons. The Plant Operations Committee, Mr. Lloyd reported, hopes to enlarge its program of collecting and reporting safety data and to conduct a safety contest in the industry.

Completion of the society's research project on nodular iron, conducted at the Southern Research Institute, Birmingham, was reported by Leon J. Wise, Chicago Malleable Castings Co., chairman of the steering committee on the project. This investigation was conducted to determine the competitive position of nodular iron and what possibilities it offered as a product for malleable iron foundries. Stating that the project was successful in determining these points, Mr. Wise recommended a continuation of the research on nodular iron on a modest scale.

RALPH T. RYCROFT, (left), newly elected president of the Malleable Founders' Society for 1950-51, is president, Kencroft Malleable Co., Buffalo. Mr. Rycroft formerly was president of the Jewell Alloy & Malleable Co., Buffalo. He was one of the organizers of Western New York Chapter of the American Foundrymen's Society and has served as president and a director of that chapter, as well as a national director of the AFS. He was vice president of the Malleable Founders' Society last year.

CAL C. CHAMBERS, (right), new vice president of the Malleable Founders' Society, is president and general manager, Texas Foundries Inc., Lufkin, Tex. Mr. Chambers was educated at Culver Military Academy and University of Wisconsin. During World War I he served overseas as a lieutenant colonel. In 1922 he was made a colonel, War Department General Staff, U. S. Army, and from 1922 to 1931 served as executive officer, Culver Military Academy. Mr. Chambers was treasurer and vice president, Wrought Iron Range Co., St. Louis, from 1931-1938 and vice president-general manager, Southern Malleable Iron Co., East St. Louis, Ill., from 1935-1938. He became executive vice president, Texas Foundries in 1938 when that company was organized and has been president and general manager since 1939.

Frank O. Parker (left), vice president, Dayton Malleable Iron Co., Dayton, O., receives the McCrea medal from Ralph N. Cole, president, Canton Malleable Iron Co., Canton, O., for outstanding service to the malleable castings industry

Product quality received considerable attention at the ten shop practice meetings held by the society during the past year, it was stated by James H. Lansing, technical and research director. Mr. Lansing urged that society members make increased use of their test bars as a check on conditions contributing to poor quality, such as presence of primary graphite. He also referred to a new ASTM specification covering pearlitic malleable iron, calling for 4 per cent elongation, 53,000 pounds yield strength and 90,000 pounds ultimate strength.

Managing Director, Lowell D. Ryan, in paying tribute to activities of the society's officers, directors ad committee members, urged that increased emphasis be placed on the superiority of malleable castings in the continuing effort to expand the market for malleable. Looking into the future, he expressed the hope that the goal of 1 million tons might be achieved, that the industry safety rate might be reduced to not more than 5 or 10, and that the malleable industry might become less dependent on one industry for over half of its business.

An interesting study of what employees think about pension plans was presented by Walter G. Barlow, vice president, Opinion Research Corp., Princeton, N. J. Questioning a representative group of rank and file workers in industry, resulted in these conclusions: Most workers would prefer to provide for their old-age requirements by their own initiative, but feel they need help in doing it. They would prefer to receive this help from industry rather than from government. A majority today would rather have a pension plan than an increase in wages. Most individuals, including those now served by a pension plan financed wholly by their employer, feel that they also should contribute to such a fund. Mr. Barlow cited instances in which employees are unaware of

(*Please turn to page* 154)

ASTM FEATURES COMMITTEE REPORTS

At Its Recent Annual Meeting

By FRANK G. STEINEBACH
Editor
THE FOUNDRY

PROGRAM of the annual meeting of the American Society for Testing Materials, held at Atlantic City, N. J., June 26-30, included a number of committee reports dealing with specification activity of interest to various parts of the foundry industry. Report of Committee A-7 on Malleable Iron Castings included a recommendation that Tentative Specifications for Pearlitic Malleable Iron Castings (A220-48T) with some revisions including the addition of a new grade, 53004 with a typical brinell hardness range of 197 to 241, be advanced to standard.

During the past two years a special committee considered the possibility of recommending tentative specifications for Malleable Iron Flanges, Pipe Fittings, and Valve Parts (A277-44T) to advancement to standard. Letter ballot indicated a majority approval, but due to the fact that a sizable minority was opposed to the action, Committee A-7, at a meeting on Monday prior to the presentation of the report, voted to organize a regular subcommittee dealing with the subject and refer the tentative specification to that committee for further study and recommendation. Therefore, tentative specification (A277-44T) will continue for another year.

A report of Committee E-7 on Nondestructive Testing recommended that Tentative Industrial Radiographic Standards for steel castings (E71-47T) be continued in their present form for another year. It was reported that Subcommittee II on radiography for steel welds has completed preparation of one set of samples and two more are in progress. Subcommittee III on magnetic particle and fluorescent penetrant testing of steel castings will limit its activities initially to magnetic particle testing of large steel castings (over 20 in. in any dimension) and begin by preparing a set of specific recommended procedures giving detailed information.

Report of Committee A-1 on Steel carried the information that Tentative Specifications for Alloy-Steel Castings for Pressure Containing Parts Suitable for High Temperature Service (A217-49T) has been approved by the administrative committee on standards. It also was reported that a proposed specification for steel castings for steam turbine casings is being developed by Subcommittee VIII on steel castings and is expected to be acted upon by Committee A-1 and the society during 1950. Various changes in the Tentative Specifications for Mild to Medium Strength Carbon-Steel Castings for General Applications (A27) including raising the maximum permissible silicon content, and in Tentative Specifications for High Strength Steel Castings for Structural Purposes (A148) including changing the yield requirements of grade 120-100 are under consideration.

Report of Committee B-7 on Light Metals and Alloys, Cast and Wrought, indicated that the administrative committee on standards had accepted tentative revisions of Tentative Specifications for Aluminum-Base Permanent Mold Castings (B108-48T) and Aluminum-Base Alloys in Ingot Form for Sand Castings, Diecastings and Permanent Mold Castings (B179-48T).

Committee B-7 has recommended revisions for Tentative Specifications for Aluminum Base Alloy Sand Castings (B26-48T); Specification for Aluminum-Base Alloys in Ingot Form for Sand Castings, Diecastings and Permanent Mold Castings (B179-49T) and Specifications for Aluminum-Base Alloys for Permanent Mold Castings (B108-49T). Editorial changes in Tentative Specifications for Magnesium-base alloy Sand Castings (B80-49T) and specifications for magnesium-base alloy permanent mold castings (B199-49T) also have been proposed.

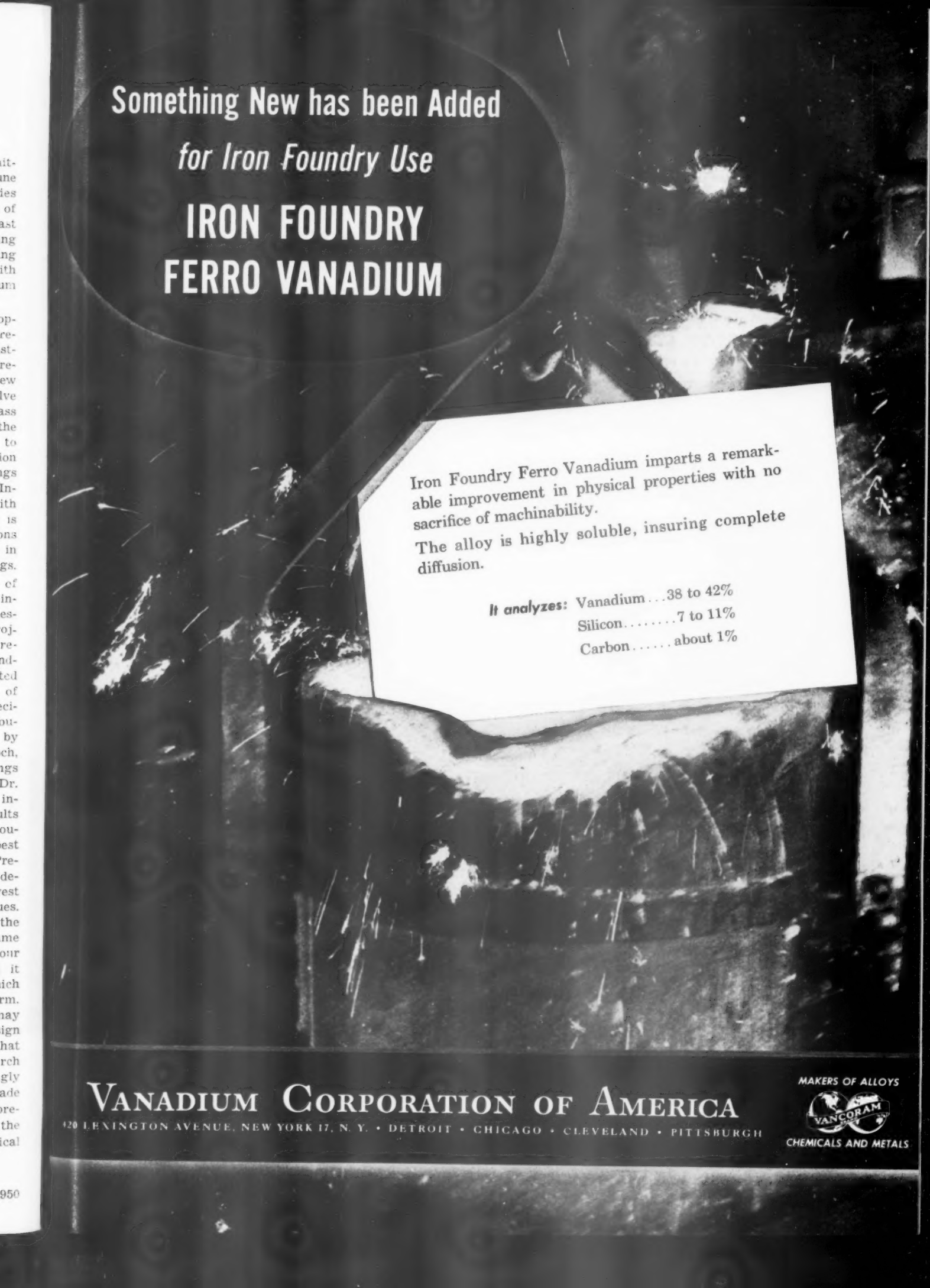
Report of Committee A-3 on Cast Iron indicated that revisions to Tentative Specifications for Foundry Pig Iron (A43-45T) and for Gray Iron Castings for Pressure Containing Parts for Temperatures Up to 650° F (A278-44T), had been approved previously by the standards committee. The committee recommended the reaffirmation of Standard Specifications for Cast Iron Culvert pipe (A142-38) and for Gray Iron Castings for Valves, Flanges and Pipe Fittings (A126-42). It also recommended the publication as tentative of the Proposed Methods of Impact Testing of Cast Iron, as appended to the 1949 report of Committee A-3.

The committee also reported the organization of Subcommittee XXVI on Nodular Cast Iron, with T. E. Eagan, Cooper-Bessemer Corp., Grove City, Pa., as chairman. That subcommittee held a lengthy meeting on June 29, and decided to undertake studies which may lead to the development of specifications covering nodular cast iron. General opinion at the meeting indicated the possibility of providing specifications on two grades, with only one grade including minimum elongation.

Committee B-5 on Copper and Copper Alloys, Cast and Wrought, reported that Subcommittee F1 on Castings and Ingots for Remelting is reactivating the task group to review specifications B61 for steam or valve bronze and B26 for composition brass or ounce metal and is studying the preparation of a document similar to the Code of Procedure in Inspection of Copper-Base Alloy Sand Castings adopted by the British Standards Institute in 1947. In co-operation with Committee E-3, the subcommittee is studying the revisions of provisions for sampling for chemical analysis in specifications for ingots and castings.

A number of technical papers of particular interest to the foundry industry were presented at several sessions. The report of a research project conducted for the technical research committee of the Steel Founders' Society of America was reported under the title, "Reproducibility of Results of Tension Tests on Specimens Prepared from Cast Steel Coupons." The paper was prepared by Dr. H. A. Schwartz and W. K. Boch, National Malleable & Steel Castings Co., Cleveland, and presented by Dr. Schwartz. Reports of the tests indicate the uniformity of test results depends upon the design of the coupon that is used. No one single best form of coupon was indicated. Presumably the most desirable coupon design would be that having the lowest degree of scatter of the test values. However, it was pointed out that the coupon design does not have the same order of rating for each of the four mechanical properties tested and it therefore is a matter of choice which property should be kept most uniform. From that choice, once made, it may be possible to select a coupon design and base further specifications on that form alone. A result of the research also indicated that a surprisingly large number of tests must be made for a single heat of steel if any precise knowledge is achieved as to the true average value of the mechanical

(*Continued on page* 115)


Something New has been Added
for Iron Foundry Use
IRON FOUNDRY
FERRO VANADIUM
Iron Foundry Ferro Vanadium imparts a remarkable improvement in physical properties with no sacrifice of machinability.
The alloy is highly soluble, insuring complete diffusion.
It analyzes: Vanadium...38 to 42%
Silicon.....7 to 11%
Carbon.....about 1%
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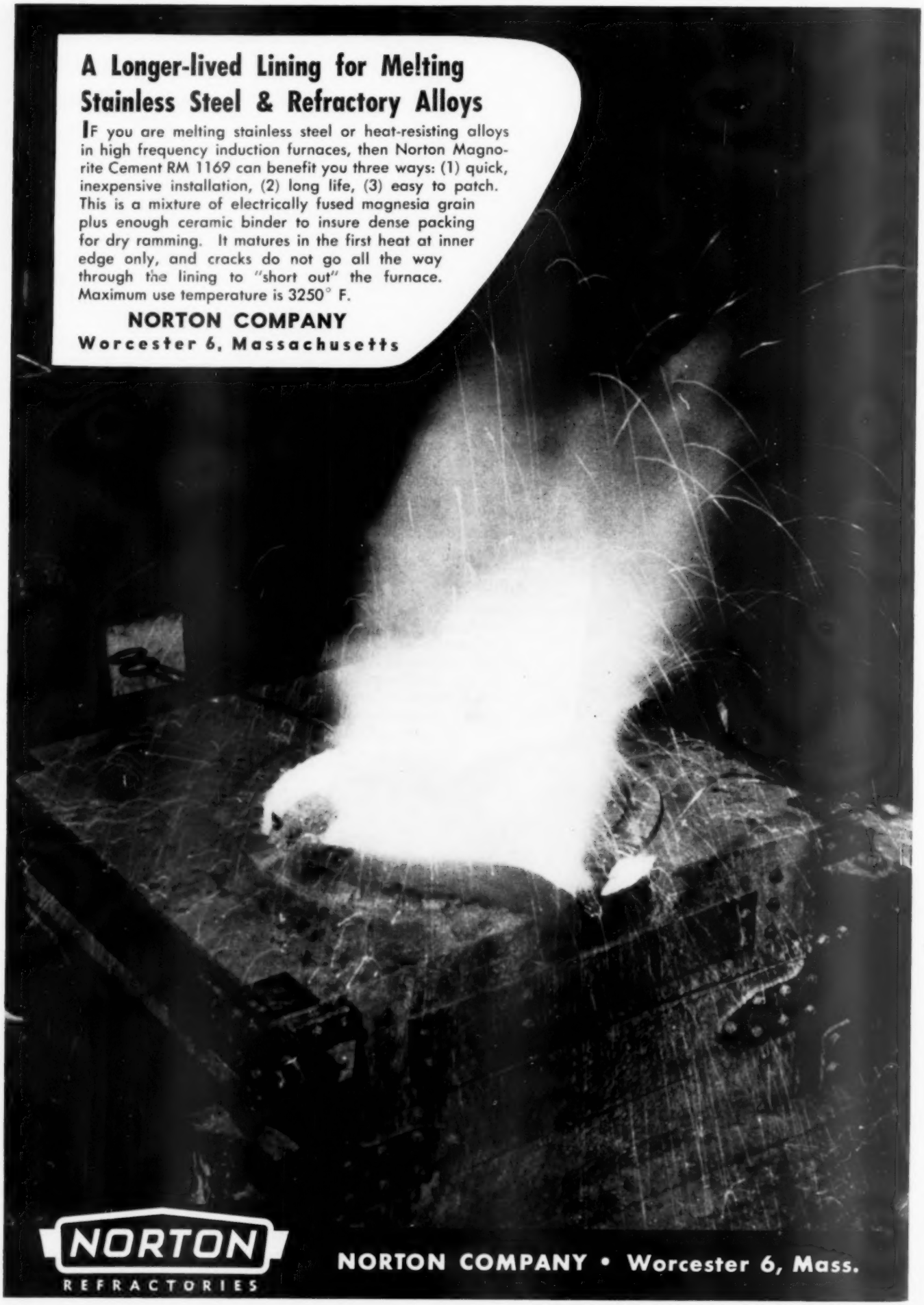

NORTON
REFRACTORIES

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(*Continued from page* 112)

properties of that heat.

A paper entitled, "Magnesium-Cerium Cast Alloys for Elevated-Temperature Service," prepared by K. Grubee and L. W. Eastwood, Battelle Memorial Institute, Columbus, O., was presented by Mr. Eastwood. The general aim of the work described in the paper was to obtain casting alloys having better foundry characteristics than those of EM61 alloy (6 per cent rare earths, 1.5 per cent manganese) and better load carrying capacity at 600° F, and possibly better foundry characteristics than alloys of the E6 type (6 per cent rare earths). Six per cent cerium was selected for study as a compromise between cheaper and lower density alloys of lower cerium content. Manganese also was employed in most of the alloys because of its beneficial effect on tensile properties and creep resistance at 600° F.

Lower Cerium Content

The alloy of optimum composition tentatively selected is as follows: Cerium 6 per cent, manganese 0.8 per cent, nickel 0.2 per cent and tungsten 0.02 per cent. The possibilities of lowering the cerium and employing zirconium and beryllium in this composition look promising, but these variations in composition have not been fully evaluated. A comparison of the properties of this alloy with four other cerium-containing alloys and the aluminum-base alloy No. 142 is included in the report. Examination of the data shows the superiority of the experimental alloy of optimum composition. Its creep resistance at 600° F is similar to that of EM62, but has the advantages of having higher tensile properties and being much finer grained as cast.

A paper "Aluminum—6 Per Cent Magnesium Alloys for Elevated-Temperature Service," by L. W. Eastwood, Webster Hodge and C. H. Lorig, Battelle Memorial Institute, Columbus, O., recorded the results of a study to improve creep properties in those alloys at 600° F. As a result of development work, the following composition was proposed for castings for elevated temperature service: Magnesium, 6 per cent, manganese 1 per cent, copper 1.5 per cent, vanadium 0.1 per cent, zirconium, 0.25 per cent, titanium, 0.08 per cent, beryllium, 0.005 per cent, and aluminum (99.5 per cent) balance. Such alloys were reported to have the advantage of not being seriously affected by stabilization at the temperatures of tests of 400 to 700° F.

As a result their tensile properties at 600° F are high after stabilization at the test temperature. In addition, their density is low, their resistance to corrosion is excellent and the machining characteristics are satisfactory. On the other hand, as compared with 142 alloy, the experimental alloy developed has somewhat poorer foundry characteristics. In addition, its thermo-conductivity is substantially lower, which probably limits its use to applications where heat dissipation is unimportant. The creep properties of the experimental alloy are better than the previously known 6 per cent magnesium alloys, but somewhat inferior to 142 alloy.

Preparation, identification of microconstituents and some mechanical and physical properties of chromium base alloys, particularly of the 60 Cr, 15 Fe, 25 Mo type were discussed in a paper "Chromium-Base Alloys" prepared by W. L. Hovekotte, C. T. Greenidge and H. C. Cross, Battelle Memorial Institute, Columbus, O. Most of the alloys were prepared by melting and casting in vacuum. Enough alloys were melted at atmospheric pressure under the lime-alumina-magnesia slag to indicate that this method holds promise for producing alloys which at high temperature are almost as strong as vacuum melted alloys. Tests were conducted on the investment casting of the alloy as turbine blades, using most of the available investments. Castings with sufficiently smooth surfaces were not obtained but it is believed zircon or beryllium-base refractories might produce satisfactory surfaces if a suitable binder can be developed.

The 100-hour rupture strengths of the best 60 Cr, 15 Fe, 25 Mo, and 58 Cr 15 Fe, 25 Mo, 2 Ti type alloys at 1600° F were 44,000 and 55,000 psi respectively. In room-temperature bend tests the maximum bending stress increased with decreasing grain size. For any particular grain size, the maximum bending stress tended to increase with an increasing oxygen content, but an exact relationship was not established. Impact tests on unnotched charpy bars at temperatures between 80 and 1800° F revealed that the alloy is shock sensitive and has no transition temperature within this temperature range.

Industry is constantly taking greater interest in nondestructive testing as an inspection tool. This fact was emphasized by H. H. Lester, Watertown Arsenal, Watertown, Mass., and was proved by the exceptionally large attendance at a symposium on the role of nondestructive testing in the economics of production. The symposium was designed to acquaint engineers and management with the advantages and uses of nondestructive testing and was sponsored by ASTM Committee E-7 on Nondestructive Testing. The first paper was entitled, "A Basic Guide for Management's Choice of Nondestructive Tests," and was prepared and presented by Robert C. McMaster and Samuel A. Wenk, Battelle Memorial Institute, Columbus, O. The paper summarized the basic principles and essential parts of nondestructive tests and presented the significant features of 12 basic test methods described in more than 250 patents and about 500 technical articles.

It was pointed out that nondestructive testing methods are being used by a good cross section of industry. While it is difficult to get actual figures, a study has indicated that during the past year $3 million was invested in nondestructive testing equipment, $15 million in supplies and $5 million in labor costs. It was emphasized that nondestructive testing must be reliable and the tests must be made properly by skilled inspectors and cover all possible defects or discontinuities.

Nondestructive Tests

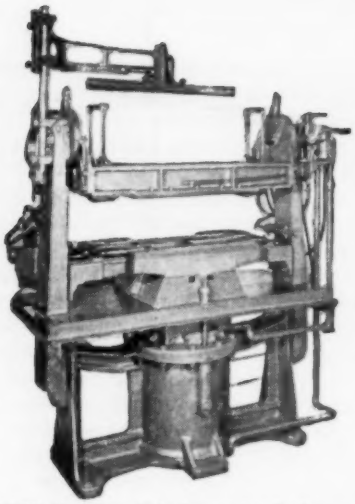
Kent R. Van Horn, Aluminum Co. of America, Cleveland, presented a well-illustrated discussion on "Defects or Discontinuities That Can Be Revealed in Cast or Wrought Metal Products by Nondestructive Tests." Mr. Van Horn emphasized the economic aspects of the problem and stated that the tests selected must be the cheapest which will give the information desired. Identification of the data revealed by nondestructive testing is important. Because many of the defects and discontinuities are called by a wide variety of names, a committee of ASTM has been engaged in reducing the terms to a small number which would include any particular type of defect revealed by the nondestructive test. The speaker pleaded with various technical organizations and others to identify defects and discontinuities in terms that will help the producer to recognize the defects.

A series of slides was used to illustrate the following six types or classifications of defects which can be revealed by radiograph or gamma ray inspection: Gas, shrinkage, segregation, sharp discontinuities, miscellaneous, and welds. In this connection the point was emphasized that careful study of the surface of the material should be undertaken before any tests are made. It is altogether possible that surface defects may be considered as internal defects if such a study is not made.

Another paper was entitled, "The Role of Nondestructive Testing in the Economics of Castings," and was pre-

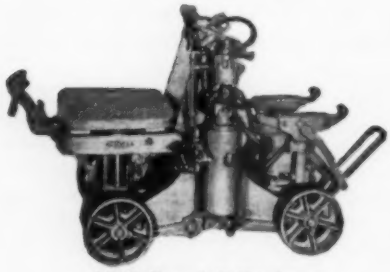
(*Please turn to page* 139)

#193 Osborn Blower, draw piston type

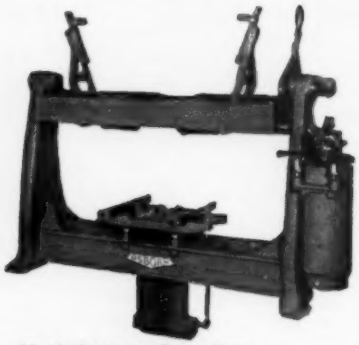


#333 Osborn Jolt-Squeeze Rollover

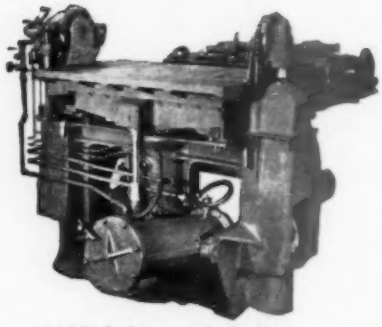
#94 Osborn Core Blower



#442 line Jolt Rockover Machine



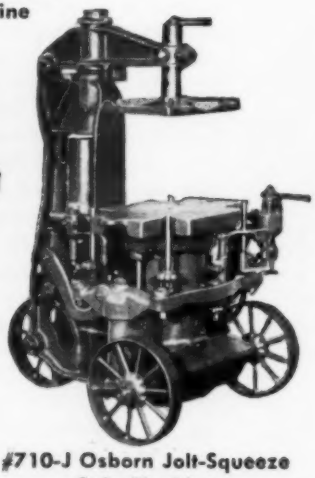
#146 Osborn Core Box Drawing Machine



#405 Osborn Jolt Rollover

#539 Osborn Jolt Strip Machine

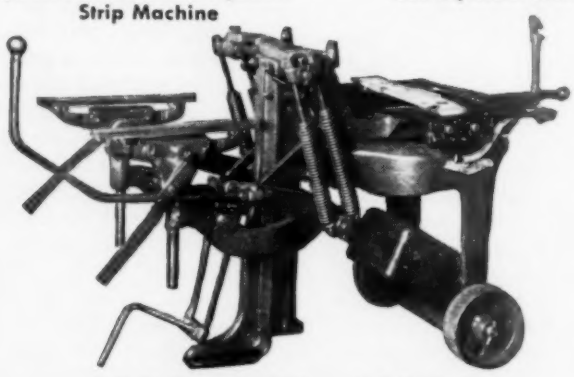
#559 Osborn Jolt Strip Machine



#710-J Osborn Jolt-Squeeze Strip Machine

#210-PJ Osborn Jolt Squeeze Machine

#413 Osborn Jolt Rollover



#42 Osborn Hand-Operated Rockover Core Machine

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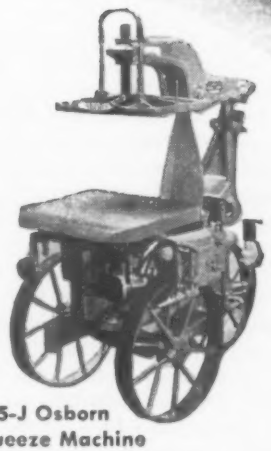
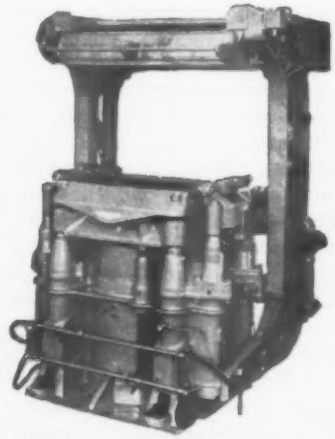
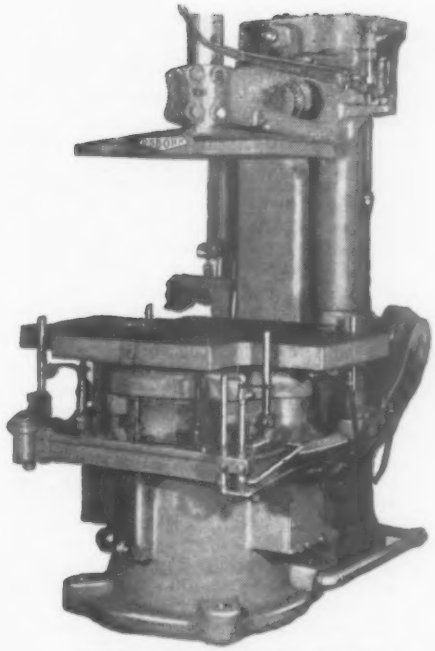


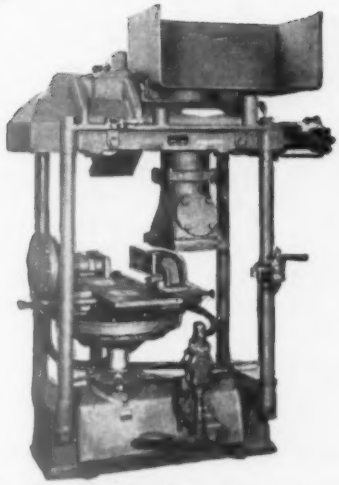
#275-J Osborn
Jolt-Squeeze Machine



#1024 Osborn Jolt-Squeeze
Strip Machine



#724-PJ Osborn Jolt Squeeze
Strip Machine



#93 Osborn Core Blower

MEMBER
MANUFACTURER'S ASSOCIATION INC
FOUNDRY EQUIPMENT

OSBORN®

MOULDING MACHINES

CORE BLOWING MACHINES

Brake Drum Materials

(*Continued from page* 84)

drum and the tire rim."

If designers find ribs necessary to improve sectional modulus and minimize weight it would be much better to machine them in than to cast them in for two definite reasons. It minimizes molding problems and decreases inherent casting stresses. This, of course, does not hold true for the "centrifused" type of drum.

I am indebted to A. S. Van Halteren, brake engineer of Motor Wheel Corp., for the following contribution to this paper:

"Evolution of the bomber drum—Due to the high loading per unit of area and per pound of drum the airplane brake has developed several fundamental principles of design in order to avoid excessive drum shrinkage, heat checking, and consequent rupture, as follows: 1. A uniform distribution of mass. 2. Ribs with an included angle of 50 to 90 degrees. 3. Sufficient mass to avoid critical temperatures."

The designs shown in Fig. 4 experienced frequent failures through rupture, although the kinetic energy loading per pound of drum was only 40 per cent of current practice.

Harold Adams of Douglas Aircraft Co. explained in detail back in 1941 why the early airplane drums failed. His findings were based on experience with a drum section as shown in Fig. 4A. His theory rested on the fact that a high rib with no taper is virtually a shrink band because of the difference in temperature between the inside of the drum and the top of the rib during a brake stop.

Quotes from Letter

The following quotation is taken from comments by Mr. Adams, quoted in a letter of Mar. 11, 1941, by E. H. Heinemann, chief engineer of Douglas, entitled "Comments on Thermal Stresses in DC-4 Brake Drums:"

> "During the first flight tests of the DC-4 trouble was experienced with brake drum shrinkage. A theory was developed to explain this shrinkage . . . . The theory also was found to explain the cracking of cast iron brake drums.
>
> "This theory is explained as follows: When the brakes are applied, heat is generated at the rubbing surface at a certain rate. If all of this heat is transmitted through the brake drum and radiated from its outside surface a temperature gradient will exist through the brake drum, that is, the inner surface will be hotter than the outer surface. If the same amount of heat is absorbed in the drum, rather than conducted through the drum, the temperature gradient varies from that for 100 per cent conduction at the inner surface to 0 at the outer surface. Since in an actual airplane brake drum most of the heat is absorbed, a probable temperature gradient curve can be drawn.
>
> "Since the inside of the drum is much hotter than the outside it will tend to expand, but since it is restrained by the cold metal on the outside of the drum it cannot expand and therefore is stressed in compression which, of course, causes a tension stress in the outside. These stresses cause no harm as long as they do not exceed the yield point. However, if the metal on the inside fails in compression or 'upsets,' then when it cools down this inner drum surface, which has been upset, now tries to go back to an inside diameter smaller than its original inside diameter. As it is still a part of the drum however, it cannot shrink without pulling the outside diameter down also. This it does, setting up tension stresses in the inside of the drum and compressive stresses on the outside. If the material on the inside is weak in tension, as for instance, cast iron, it fails in tension upon cooling and cracks rather than shrinking the drum."

Mr. Adams suggested cross drum cuts or slots on either the inner or outer surfaces, but this is not practical for current loading because it would make the drum section too weak in tension at critical temperatures. A desirable increase in heat radiating surface can be obtained by using ribs with parallel surfaces but under the intensive loading the shrinkage and heat checking would be excessive and dangerous due to the temperature differential as explained by Mr. Adams.

To provide sufficient mass and strength without developing too high a differential in temperature between the inside and outside diameter of the drum we have been forced to compromise by using ribs with included angles varying from 50 to 90 degrees. The wide included angle of the rib intensifies the heat flow to the top of the rib so that the differential in temperature between the inside and outside diameter of the drum is held to a safe limit for stability.

Under normal loading these designs will develop some desirable shrinkage which compensates for wear. For brake loads up to 15,000 ft-lb per swept sq in. of drum the design in Fig. 4C is ample. The ribs shown in Fig. 4D are satisfactory for 21,000 ft-lb per sq in. and the metal distribution in Fig. 4E with an inside diameter of 21½ has qualified with a load of 32,800 ft-lb per sq in. and 117,000 ft-lb per pound of drum. The brake used in combination with the drum shown in Fig. 4E weighs 77 lb which, with a load of 15,500,000 ft-lb, figures 74,000 ft-lb per pound of drum plus brakes.

Airplane drums are designed to absorb and hold about 92 per cent of the kinetic energy at a temperature of 1075° F at the end of the stop. About 6 per cent is absorbed by the brake parts and about 2 per cent is dissipated through the drum during the stop.

Thermal calculations confirmed by dynamometer potentiometers show that 10 minutes after the stop the drum temperature has dropped 525° F and 65 per cent of the energy absorbed has been dissipated by conduction, convection and radiation, which reveals an essential advantage of the drum type of brake.

All of the materials involved in an airplane wheel and brake are susceptible to deterioration under heat, so that the heat dissipating capacity of a brake assembly is a very important consideration in wheel and brake design.

A comparison of the drums used in 1939 on the B17 and the drum used on the B47 in 1948 gives a good example of the progress made in airplane brake drum design, loading per unit of area and per pound of drum during the last decade. Namely, from 5080 to 32,800 ft-lb per swept sq in. and from 46,150 to 117,000 ft-lb per pound of drum.

All of these factors and many others enter into the final compromise which in turn is controlled by design factors and ultimately by operating conditions. Thus, it is obvious that if a manufacturer could be certain that the brakes on an individual vehicle would be operated under predetermined limited conditions, he could select a specific cast iron and design within relatively small factors of safety without resorting to compromises. This, of course, can never be accomplished because of four uncontrollable variables in environment: Operators, traffic, topography, and atmosphere.

Design Is Compromise

The designing engineer has at his command many known factors arrived at through endless testing, studies of service conditions, and studies of failures, all of which help him to arrive at his compromise brake drum from design and material standpoints.

The life expectancy of a brake drum can be summed up as follows: Resistance to thermal fatigue, resistance to wear and galling or scoring, and resistance to mechanical breakage. Thermal fatigue is a function of design, expansion, conductivity, rate of heat input and the number of cyclic heatings. Wear and galling are functions of structure, hardness and fusion point. Mechanical breakage is a function of strength and design.

While the title of this paper implied that there may be many suitable materials for brake drums it seems apparent for the present at least that high total carbon cast irons fulfill the requirements of the braking surface to a greater extent than any known alloy discovered to date. This is verified by experience and theory and by unsuccessful attempts to utilize other alloys. I do not mean

to imply by this that cast iron is the ultimate because I know that brake engineers and vehicle operators are demanding something better. This is only natural and encourages research which is the forerunner of progress and directs us on the route to greater perfection.

In the preparation of this paper I have purposely avoided any discussion of one of the paramount problems confronting brake engineers and that is the noise problem. Whether this is a factor relating to brake drum material, design of brake mechanisms or the proper mating of the friction material with the drum remains to be determined and offers an open field for experts in acoustics. Throughout the paper I have endeavored to give credit to those who have supplied information and helpful suggestions for which I wish to express my sincere appreciation. Also I should like to thank R. W. Mason and Dr. R. F. Thomson of the Detroit Technical Section of International Nickel Co. for their cooperation and suggestions.

SANDS

(*Continued from page* 85)

in the oven long enough to dry the sand to a depth of an inch or more, the extent of the drying depending upon how much time is to elapse before the molds are closed and poured.

In using portable driers for this purpose, the cope generally is set on short spools on top of the drag, right side up, and the air is sent down one or more of the heads, and out through others, or through the opening between the two parts of the mold. In the latter case, much of this space may be closed with sheets of asbestos or metal.

Electric resistance grids and batteries of infra-red lamps also are used to some extent for the same purpose. They do not, of course set up a circulation of air as do the portable dryers, except that they cause the heated air near them to rise, and cool air to flow in to take its place. So far as the author knows, only comparatively small molds are dried in this manner.

Molds are heated long enough to eliminate the moisture from a surface layer so deep that in the interval between drying and pouring diffusion from undried areas in the body of the mold will not make the surface sand too damp. The required depth of drying will depend therefore upon how long it takes to core up and close the mold, and how long it must then stand before the steel is available to pour it. The first factor depends upon how complicated the piece is, the latter upon the melting and pouring schedule of the shop. When converters or small electric furnaces are used, the steel is made in small lots at short intervals, and the waiting time need not be long; in open hearth shops it may be a matter of several hours.

Sand mixtures for work of this type may be bonded with clay, with clay and bentonite in varying proportions, or with bentonite only. The latter has the advantage over clay that it requires less moisture to produce a given green strength. To minimize the drying time and the tendency of the moisture to draw back into the surface sand, the moisture should be kept as low as is consistent with proper moldability and green strength. For this reason bentonite mixtures are preferred by many foundrymen.

The fact that in bentonite bonded sands, the moisture migrates from one layer to another more slowly than in clay bonded mixtures, also makes bentonite the preferred material for bonding the sand in partially dried molds. The moisture content in sands of this sort generally is kept at a low figure, from 3 to 4 per cent being probably a fair average, and a cereal-bentonite ratio of roughly 1 to 3 is preferred. A permeability considerably higher than that of dry sand mixtures is desirable, and a fair degree of green strength is essential. In addition to cereal and bentonite, lignin type binders may be used to keep the surface of the mold from drying out too rapidly. The amount of liquid binder used, however, is much less than generally is added to regular dry sand mixtures.

Patch The Cracks

Dry sand molds almost always are given a coat of wash, and may be given another while still hot. Generally there are a number of cracks in the surface of the mold, which must be patched by cutting away the sand with the molder's trowel, and tucking in heavily bonded sand to fill the space. These patches should be dried with the torch, and then given one or two coats of wash.

Deep skin-dried molds also usually are washed, especially at the areas near the gates. In all but quite small work, tile down-gates are used, and in heavy dry sand molds the runners carrying the metal to the mold cavity are also preferably of tile. For medium sized castings, the runners may be made entirely or in part of cores, or may be molded in the sand heavily washed. If the runners are to be made in the sand, they preferably should be rammed against a pattern, rather than cut with the trowel, because the rammed sand has a harder, tighter skin than can be secured by slicking down a cut surface.

True green sand molding is used chiefly for really light castings, and as a rule synthetic sands bonded with cereal and bentonite, with moisture below 4 per cent, a high permeability and a fair green strength are to be preferred. Lignin type binders may or may not be used. As they assist in slowing up skin drying, they are not desirable if the molds are to be poured soon after being rammed up. When the core setters and finishers have a good deal of work to do before the molds can be closed, it is as well not to have the sand air-set too quickly, and in that case lignin is a desirable constituent of the mixture.

Temper the Sand

In past years the backing sand was always taken from heaps on the foundry floor, and in a few foundries this practice is still followed. Molders add water to the heaps and cut them over with a shovel, each man "tempering" his sand to what he considers a proper feel. Naturally, no two men will bring their sand to the same moisture percentage, and while one molder may have the permeability of his sand higher than that of the facing, another may get his backing far too "tight". Most plants today follow the much better practice of giving all the sand at least a short mixing in the mullers or other machines, so that the right amount of moisture is distributed evenly through each batch. If necessary a little clay or bentonite and a small amount of lignin-type binder is added to maintain the green strength at a proper figure.

In former years the sand was knocked out of the flasks by hand, but today even in small foundries, vibrating mechanical shake-outs almost always are used. On these the gaggers and the large cores and lumps of hard sand are screened out, the loose sand passing to a conveyor belt. In many foundries it then goes to a revolving or vibrating screen to remove the smaller lumps, and then to a covered storage space large enough to hold several days' supply, so that it does not have to be used hot.

When this is not possible, the sand must somehow be cooled enough to keep it from drying out too fast after mixing. Water may be sprayed on the sand on conveyor belts that carry it to the bins supplying the mullers, and extra water may have

to be added to the mixture so that when the molders use it the moisture content will be correct. In shops that do not have extensive sand handling equipment, hot sand, especially in summer, adds greatly to the troubles of the foundryman in making satisfactory molds that do not have to be wet down by the finishers to keep them from crumbling under the slicking trowel.

When the sand is screened merely to take out the hard lumps, it is necessary to use a considerable proportion of new sand in the facing mixtures. As most of the internal cores also are made of new sand, the total amount brought into the shop every day is quite large and to keep the floors from being completely filled up, a corresponding amount of old sand must be sent to the dump. The average consumption in foundries that merely screen their sand before re-using, runs from 1 to 1½ tons of new sand per ton of castings produced. The smaller the proportion of old sand incorporated in the facing, of course, the greater the consumption of new material.

The clay and bentonite in the part of the mold that is highly heated by the steel completely lose their bonding power, and remain in the sand as inert fines. Several of the other binders, such as gilsonite, glue, some of the synthetic resins, even lignin leave a considerable amount of ash in the sand when they are burned out by the heat of the steel. Thus the permeability of the sand tends to decrease steadily with re-use, and the inert fine material makes it necessary to add extra new bond to obtain the required strength.

Reduce Sand Strength

At the same time, the oils, cereals and other organic binders produce a large amount of black carbonaceous residue, which adheres firmly to the sand grains and reduces the strength of the mixtures in which old sand is incorporated. When naturally bonded sands are used there is not much that can be done to take care of the accumulation of inert fines and baked-on carbonaceous material. Enough new sand is brought into the shop to make up the desired proportion of the facing, a corresponding amount of old sand is sent out, and thus the proportion of fines and carbonaceous residue is prevented from becoming too great. With synthetic sands, however, partial or complete reclaiming is highly desirable.

To keep the sand in synthetic mixtures from deteriorating too rapidly, some of the dust may be removed by the suction fans exhausting the air from revolving or vibrating screens. A more satisfactory type of equipment is a cascade unit, which consists essentially of a sort of stair case, with inclined treads but no risers, down which the sand flows. A fan draws air through the spaces between the treads, and both the width of these openings and the inclination of the treads can be varied at will.

The sand that passes over the cascade then goes to a vibrating screen that takes out the smaller lumps, and the screened sand goes to the mixing pans or to storage. The air carries the fine dust completely out of the machine, and draws the fine sand grains away from the cascade, and into chutes divided by a partition to separate the usable material from the portion too fine for re-use. The latter portion is sent out to the dump with the refuse from the rough cleaning floor. With machines of this type, enough dust can be removed from the sand to keep the permeability from decreasing below a certain point, so that a larger proportion of old sand may be used in the facing mixtures.

Control Backing Sand

It is not absolutely necessary to treat all the sand used for backing, but it has been found that the permeability of the backing can be controlled so much better in this way that it pays to send at least a large proportion of it over the cascade unit. It is not possible, however, to clean the sand completely with dry separation, a certain amount of loose fines and almost all of the black coating on the grains remaining in it. In at least some plants not a great deal of this dry reclaimed sand is used in the facing mixtures, as too much burning on and other troubles are experienced when it is.

Sand can be cleaned and reclaimed more thoroughly with water than air alone, and wet reclaiming is used in some plants, especially when the castings are cleaned by wet-blasting methods. In wet reclaiming, the sand is mixed with a large amount of water and sent through some sort of scrubbing apparatus, such as a rotating barrel with baffles and a charge of boiler plate punchings or similar material to give a scrubbing action. Other pieces of apparatus used for this purpose have impellers revolving at high speed, which circulate the sand and water and loosen the fines on the sand grains by impact.

From the scrubbers the water and sand are sent through a classifier in order to float off the dust and fines. These machines are of several different types, but all depend upon the principle that the finer particles of sand settle much more slowly than the coarse, and so can be carried away in the water. The cleaned sand is then dewatered in centrifugal driers, or by allowing it to stand in enclosed heaps with baffles at one side through which the surplus water drains off.

To reduce the water content to the necessary degree, at least part of the sand must be heated in driers of some sort, such as inclined rotary barrels fired at one end with oil, gas or powdered coal. The hot sand from the dryer is discharged on to a belt conveyor carrying damp sand from the settling bins or centrifuges. Amounts of heated and of damp sand are so proportioned that the latter is dried out enough to bring the average moisture content of the sand on the conveyor to the desired figure.

Dry the Sand

In passing it may be remarked that in some shops the new sand is dried to a constant moisture percentage in apparatus of this type. Washed and dried sand, of course, frequently is shipped in box cars, and thus is received dry enough for use. However, other sands, that are shipped in open gondolas, contain a widely varying percentage of moisture as received at the foundry, and it usually pays to dry them to a moisture content below that desired in the mixtures of which they are to form a part. Complete drying of sands handled on belt conveyors is not desirable, as in that condition sand is none too easy to handle, and leaks through even the tiniest openings in bins and chutes. To have the sand reach the mixing floors at a constant moisture percentage, however, greatly simplifies the task of keeping the properties of the sand mixtures within the desired limits.

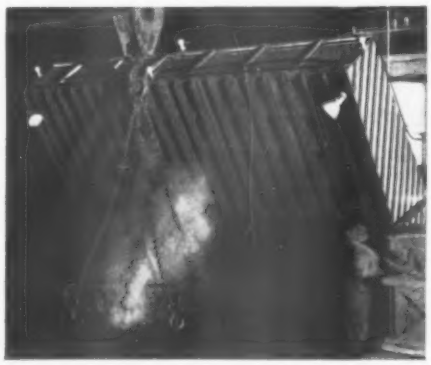
In particular, when new sand is replaced in the mixtures by reclaimed, the sintering point is lowered and the green strength reduced. For many types of steel castings, wet reclaimed sands have proved satisfactory as a substitute for at least a large part of the new sand, so that the economies attained by the use of the process are considerable. It appears to be a fact, however, that it is much less satisfactory in shops making large heavy steel castings, and in at least one instance it has proved impossible to replace sharp sand in oil bonded cores with wet reclaimed sand.

(To be continued next month)

20. Charles W. Briggs, *Metallurgy of Steel Castings*, page 365, line 13.

Above: **Bartlett-Snow "Dust-Sucker" Side-Wall Hoods** at Pouring Station of Large Production Foundry.

Smoke Hoods Over Mold Conveyors Prevent Contamination of the Air, and Cool the Castings.



Bartlett-Snow "Dust-Sucker" Side-Wall Hood at Shakeout Handling Large, Heavy, Dry Flasks.

Smoke Control

pays big dividends

● Bartlett-Snow side-wall pouring hoods — smoke hoods for mold conveyors — and side-wall or canopy hoods for shakeouts, prevent smoke and choking fumes from clouding and contaminating the foundry air, save electric light, and make foundries better, cleaner places in which to work.

Clean foundries attract a higher, more desirable type of workman. Sickness and absenteeism are much reduced, resulting in increased and more uniform production, lower casting costs and greater profits. Complete facilities to meet every requirement. The C. O. Bartlett & Snow Company, 6201 Harvard Avenue, Cleveland 5, Ohio.

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FABRICATORS ERECTORS

Around THE COUNTRY

CHICAGO — Foundrymen get small consolation from the high rate of iron production in the district. There is barely enough merchant iron to go around, and some melters pay the premium for foreign material. Probably more of the European product would be sold if it showed better uniformity. This is a common objection. Iron sellers hate to use the word "allocation." Formal or informal, however, distribution under quota is necessary for the good of all customers. Coke supply is adequate but not abundant.

Of the district's 42 blast furnaces, 40 were in operation last month. Carnegie-Illinois, with 23 stacks in all, achieved 100 per cent operation and had no plans to change this rate immediately. High consumption of iron by steel furnaces, however, prevented foundrymen getting much benefit from the achievement.

July was a quiet month for foundry activity. Vacations closed many captive and job shops, and it was said that all farm implement shops in the Tri-Cities area were closed one week or another in that month. Implement production remains at a high rate and promises continuation, total 1950 sales running only slightly under last year, in the estimation of observers. Automotive requirements show no sign of decreasing; truck castings output has had a little boost from new military orders. Freight car bookings mean welcome addition to some melters' order backlogs, but steel shortage holds releases for these somewhat in check. The steel shortage is regarded to blame for the restricted amount of business some foundries can obtain. Many have orders to support only four days a week operation.

The selective rail strike brought a few shops to a standstill. One electric furnace in the south, prevented from getting scrap, closed completely. Cast scrap market quieted down but buying by some of the biggest melters kept the drop from being steep.

To reduce administrative costs and achieve economies in production, Yale & Towne Mfg. Co., New York, early this fall will move its Sager-Barrows Lock Works Division, North Chicago, Ill., and its Norton Door Closer Co. Division, Chicago, to Berrien Springs, Mich., where the two will be consolidated in a single-story plant purchased from Clark Equipment Co., Buchanan, Mich. The brass and aluminum foundry of the Sager-Barrows Lock division will be transferred to the new location. The Chicago properties will be sold . . . Tarrant Foundry Co., Chicago, a gray iron shop with two cupolas, recently ceased operations and sold its plant and equipment to A Finkl & Sons Co., Chicago. The two plants are adjacent. The latter company is disposing of the foundry equipment and will use the plant to expand its forging and die block manufacturing.

* * *

NEW YORK—Ferrous foundry operations in the metropolitan area are due for a pick up in August. Most foundries took time off for mass vacations in July and, with casting demand on the increase, have resumed at a higher rate, and in many cases expect the improvement to continue into the fall.

Jobbing foundries last month, once vacations were out of the way, were able to boost their operations on an average to around five days a week, against four days throughout the greater part of the spring. Incoming orders are at a sustained rate. Most specialty shops are operating well and nonferrous foundries report an increase in backlogs.

Mack Truck has leased its foundry in New Brunswick, N. J., to the Sorbo-Cast Corp. of New Jersey, and is paying for the installation of some new equipment. Sorbo-Cast is said to have been organized by a group of consulting engineers, who have been studying operations at the New Brunswick foundry for the past seven months. The company will supply such requirements as Mack will need in the way of motor castings, etc., and also will book business for other consumers. Meanwhile, Mack is moving its New Brunswick manufacturing operations to Plainfield, N. J., consolidating them with those at that point. Mack expects to continue to buy castings from its regular outside suppliers. The 250 or so employees at the New Brunswick foundry will be retained.

* * *

PHILADELPHIA — District gray iron jobbing foundries are operating at around five days a week and with the vacation season largely out of the way expect to melt more iron in August than since May. Specialty plants, such as those producing pipe, sanitary ware and textile machinery parts, are operating at a high clip. One textile machinery foundry is going at six days a week. Nonferrous foundries are receiving more business. Raw materials, such as scrap and pig iron, are in easier supply, although shortage of gondolas is retarding movement to some plants. District ferrous foundries have been augmenting pig iron requirements with increasing supply of tonnage from abroad. The Budd Co. is expected to get its new plant at Red Lion in operation shortly. It will have a melt of about 20 tons an hour, producing brake drum castings.

* * *

PITTSBURGH—Vacation schedules of one to two weeks last month cut sharply into production schedules of jobbing foundries and to lesser extent among captive interests. In some instances plant shutdowns for vacations prevented a similar occurrence because of pig iron scarcity resulting from relining of Pittsburgh Coke & Chemical Co.'s Neville Island, Pa., stack.

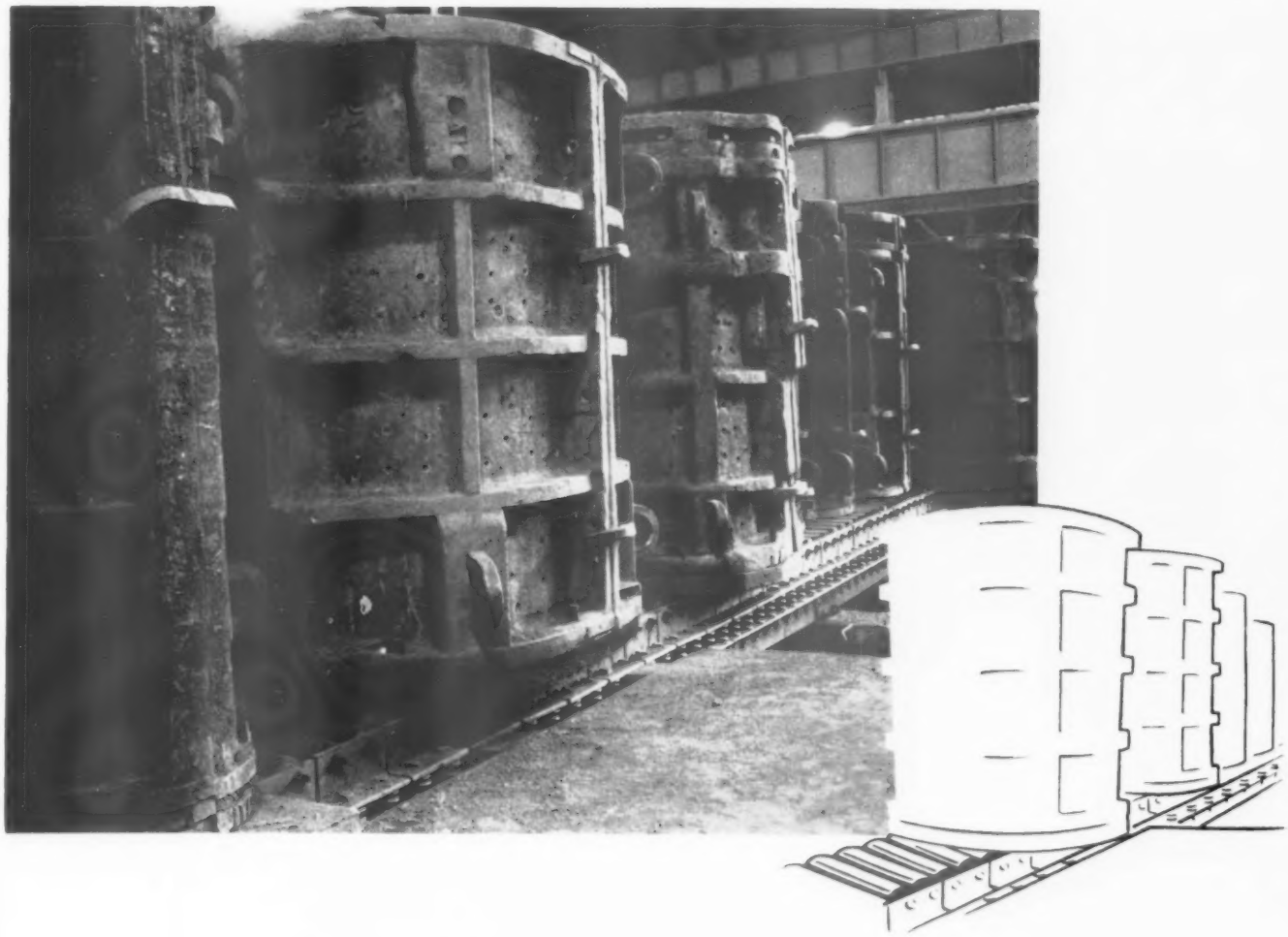
This lone merchant foundry iron blast furnace in Pittsburgh district was blown out on May 10 and was scheduled to be brought back into service during July. In addition to complete relining, the furnace has an entire new top and company has installed a new gas washer, dust collector, hoist engine and rebuilt the pig making machine.

To help offset the pig iron shortage resulting from this program, at least one foundry during the past month purchased a boatload of iron from Holland, while iron from Daingerfield, Tex., and the Birmingham districts also has been purchased by foundries here despite the exorbitant freight charges involved.

Improvement in order volume among small jobbing shops gained momentum last month, a condition which will be more fully reflected in operations throughout August now that merchant foundry stack is again pouring iron. Many gray iron jobbing shops are on full 5 days per week schedules. A substantial improvement in order volume also is noted among steel foundries, notably those making high alloy heat resist-

(*Concluded on page* 168)

Where equipment has to be *tough* to survive . . .



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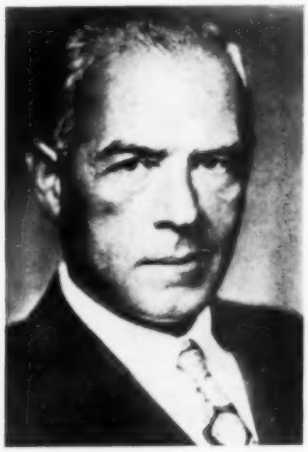
OBITUARY

GEN. THOMAS S. HAMMOND, 66, chairman of the board of directors, Whiting Corp., Harvey, Ill., died June 15 at his home in Chicago. Gen. Hammond was born in Crown Point, N. Y., and was graduated from University of Michigan. He joined Whiting Corp. in 1907 and served



GEN. THOMAS S. HAMMOND

successively as purchasing agent, assistant secretary, vice president-secretary, vice president-treasurer, and president-general manager. Gen. Hammond was active for many years in U. S. military service. During World War I he served in France with the Rainbow Division, and was discharged with the rank of lieutenant colonel. He retired as major general in the Illinois National Guard in 1940 and in 1942 entered the services of the Chicago (Army) Ordnance District, War Department, where he became district chief. He returned to Whiting Corp. in 1946 as chairman of the board.

Actively interested in trade associations, Gen. Hammond had served as president of American Foundrymen's Society, National Foundry Association and the Foundry Equipment Manufacturer's Association.

* * *

Horace Y. Seidel, 83, former president, R. B. Seidel Inc., Philadelphia, manufacturers of crucibles for 60 years, died July 4. Mr. Seidel, a native of Gibraltar, Pa., was active in the business which his father founded, until it was discontinued in 1926.

* * *

Russell G. Davis, 55, special sales representative, Chain Belt Co., Milwaukee, died May 13 at his home in Columbus, O. Mr. Davis, a graduate of University of Wisconsin, was associated with Chain Belt Co. until 1941 when he left to manage the commercial gear plant of Foote Bros. Gear & Machine Corp., Chicago. Following a short period with Lustron Corp. in Columbus, he rejoined Chain Belt seven months ago as a special sales representative, with headquarters in Columbus.

* * *

Demarest Adams, 48, executive vice president, Asbury Graphite Mills Inc., Asbury, N. J., died May 20 at his home in Easton, Pa.

* * *

Julius Tuteur, 87, founder and chairman of the Central Brass Mfg. Co., and Foundry Equipment Co., Cleveland, died there June 15. Mr. Tuteur, a native of Germany, came to the United States in 1881, and lived in Fremont, O., for 4 years. He went to Cleveland in 1885 and founded Electric Vacuum Cleaner Co., there in 1917, serving as president until 1941, then as chairman of the board until it was acquired by General Electric Co. in 1945.

* * *

George W. Pressell, 62, vice president, E. F. Houghton & Co., Philadelphia, and president, E. F. Houghton & Co. of Canada Ltd., died June 5 at his summer home in Ocean City, N. J. Mr. Pressell, who joined the company as a messenger boy 47 years ago, subsequently became chief chemist, secretary, general sales manager and director of sales. He had been a director since 1919.

* * *

Wilbur W. Thawley, 51, president, Nonferrous Foundry Inc., Philadelphia, died in his office June 5. Mr. Thawley began his foundry career with Philadelphia Bronze & Brass Corp., Philadelphia. In 1929 he became associated with Philadelphia Nonferrous Foundry Inc., where he was superintendent and sales engineer. In 1945 he and two other associates purchased the plant, which became Nonferrous Foundry Inc. At the time of his death he was also sales representative for Empire Steel Castings Co., Reading, Pa., and Carver Foundry Inc., Philadelphia. Mr. Thawley was instrumental in organizing the Philadelphia Chapter of the Non-Ferrous Founders' Society.

* * *

C. J. Shields, 77, for over 40 years, owner, Shields Pattern Works, Columbus, O. died there, June 12.

* * *

Joseph A. Krugler, 50, since 1942 vice president, Taylor-Wharton Iron & Steel Co., High Bridge, N. J., died June 19 at his home in Easton, Pa. Mr. Krugler was born in Philadelphia and spent his early life in Pottstown, Pa. Following graduation from Rensselaer Polytechnic Institute he joined the Scranton, Pa., office of Taylor-Wharton in 1924. He was transferred to the New York sales office in 1932 and became general sales manager in 1936.

* * *

Richard G. McElwee, iron foundry division manager, Vanadium Corp. of America, Detroit, died June 21 at Niagara Falls, N. Y. Mr. McElwee was born in Williamsport, Pa., and received his education in public

RICHARD G. McELWEE

schools there and in Galeton, Pa. He began his foundry career in 1915 as chief inspector, Muncie Foundry & Machine Co., Muncie, Ind. A year later he became associated with General Motors Truck Co., Pontiac, Mich., and in 1926 was appointed engineer, American Car & Foundry Co., Detroit. From 1928 to 1932 he was foundry engineer, Whitehead & Kales Co., River Rouge, Mich., and for 4 years was associated with Ecorse Foundry Co., Ecorse, Mich. He had been with Vanadium Corp. of America since 1936.

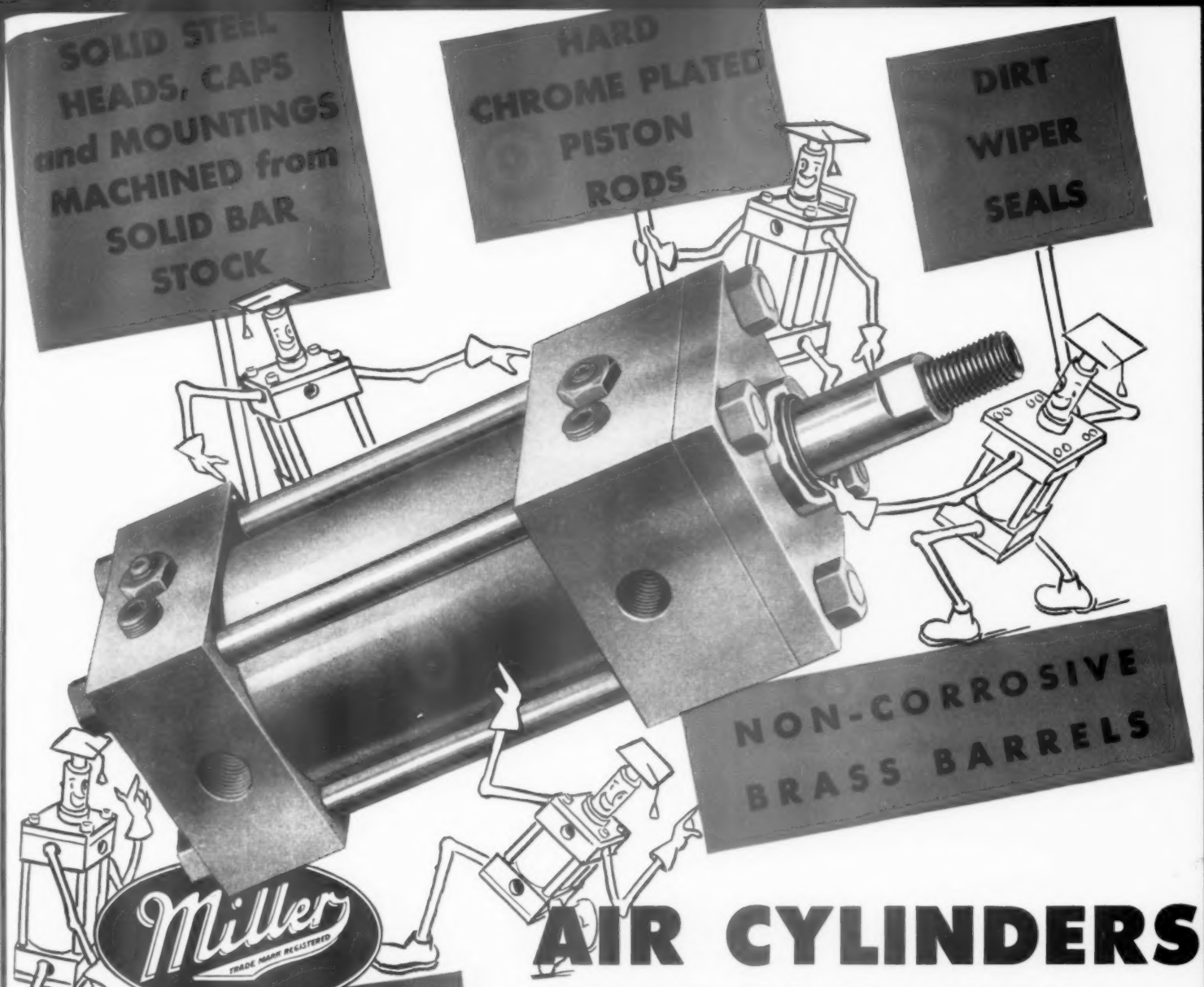
Mr. McElwee, a former chairman of the Detroit Chapter of the AFS, had served as chairman of the Gray Iron Division of the AFS, and chairman of its Cupola Research Committee. In 1948 he was awarded the John A. Penton Gold Medal of the AFS in recognition of his outstanding contributions to dissemination of information to the foundry industry and especially for his splendid efforts on the Cupola Research Project.

* * *

R. D. Wiechert, 66, director, St. Clair Foundry, Centralia, Ill., died there June 18, in St. Mary's Hospital. Until his retirement in 1945 Mr. Wiechert was president of the company which his father had founded.

* * *

Robert A. Wood, 62, until his retirement secretary-treasurer, Minneapolis Electric Steel Co., Minneapolis, died there June 28. Mr. Wood, a native of Jefferson, Iowa, had lived in Minneapolis for 45 years.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ST. LOUIS and OTHER AREAS.

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By EDWIN BREMER

Foundry DEVELOPMENTS

CAREFUL study of modification in aluminum-silicon alloys by Thall and Chalmers and reported in the March issue of the *Journal* of the Institute of Metals (Great Britain) has led the authors to formulate a new theory of modification based on the influence of sodium on the balance of interfacial tensions during solidification. In their work thermal data on modified aluminum-silicon alloys were redetermined and semi-quantitative determinations of sodium content by radioactive technique were made. Theory is based on the assumption that the aluminum interface advances more rapidly than the silicon face, and that the sodium reduces the interfacial tensions between the solid aluminum and solid silicon phases. Rapid cooling in chill-cast, sodium-free aluminum-silicon alloys serves the same purpose.

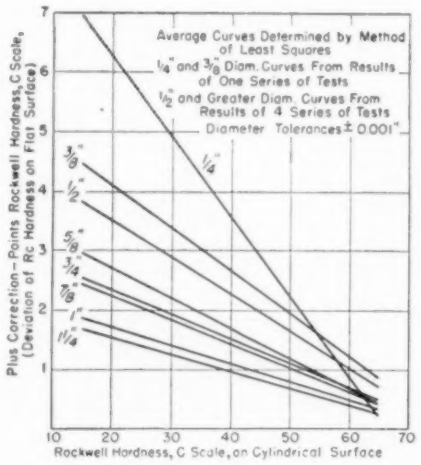
Interesting addendum is the suggestion that nodularization of cast iron by additions of magnesium or cerium follows the same mechanism. Points of agreement relating to interfacial movements are that thermal conductivity of aluminum and iron are higher than for silicon and of graphite or cementite at the temperatures involved, and that the latent heats of fusion of aluminum and of iron are considerably below those of silicon and of graphite or cementite. Hence, it is expected that iron and carbon will act like aluminum and silicon.

* * *

DETAILS of extensive research on titanium alloys now are available according to the Office of Technical Service, Department of Commerce. Report prepared by P. R. Mallory Co., Indianapolis, for the Navy's Bureau of Aeronautics, includes reference to the 5 per cent Cr-3 per cent Al, titanium alloy recently described as strong as high-strength steel with only half its weight. Tabulated results include effects of titanium alloys of carbon; copper; manganese, and silicon, alone and in combination. Report is titled PB 100,000, "The Manufacture of Titanium Alloys", and contains 108 pages. Available from Library of Congress, Photoduplication Service, Publication Board Project, Washington 25, at $4.50 in microfilm or $13.75 in photostat form.

* * *

TO DETERMINE corrections to be applied to Rockwell C hardness readings on curved surfaces, Frank W. Hussey conducted more than 2800 individual hardness readings on flat and curved surfaces of carefully prepared steel specimens of small diameter to find the deviations of hardness readings taken on curved surfaces from the "true" values of the flat areas. Results were reported at the recent ASTM annual meeting, and embodied in the accompanying graph which indicates the corrections to be applied to cylindrical surface hardness readings.



* * *

TO MEET the needs of science and industry for information on methods for determining thermal expansion of materials, one of the most important and frequently measured properties, National Bureau of Standards has issued a new circular dealing with the subject. Entitled Circular C486, "Thermal Expansion of Solids", it describes ten methods and procedures to obtain expansion equations and coefficients of expansion. These include the precision micrometric, interference, fused-quartz tube and dial-indicator, and x-ray methods. Also described are methods for determining volume changes in metals and alloys during casting. Relationships between thermal expansion, temperature, chemical composition, density, specific heat, melting point, and other properties are discussed and illustrated. Copies of the circular may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, for 20 cents each.

* * *

INVESTIGATION of "Some Effects of Austenitic Grain Size and Metallurgical Structure on the Mechanical Properties of Steel" by G. M. Sinclair and T. J. Dolan, University of Illinois, Urbana, Ill., and presented at the recent annual meeting of the American Society for Testing Materials, indicated that in general, steels having a tempered martensitic structure exhibited mechanical properties superior to those of the same steels with a pearlitic structure, irrespective of the prior austenite grain size. With exception of a decrease in ductility in static tension, the mechanical properties of steels having a tempered martensitic structure were not appreciably affected by an increase in austenitic grain size. Increase in prior austenitic grain size of steels heat treated to produce a pearlitic structure resulted in an increase in yield ratio in tension, a decrease in fatigue notch sensitivity, and decrease in amount of energy absorbed by v-notch charpy impact specimens.

* * *

FOR CHILL-CAST bronze bushings or cored sticks up to 2-in. internal diam the Tin Research Institute recommends an iron or steel core coated with asbestos paper. Core should be machined to a smooth surface and tapered about 1/32-in. per ft. Number of layers of asbestos paper should give a total radial thickness of 1/100-in. per inch diameter of the core. Paper may be moistened with a core wash composed of 5 per cent aluminum powder, 2 per cent dextrine, remainder water and sealed on with the same or dextrine paste. Core must be baked for at least 15 minutes at 600° F or better before use, and used immediately after baking to prevent reabsorption of moisture.

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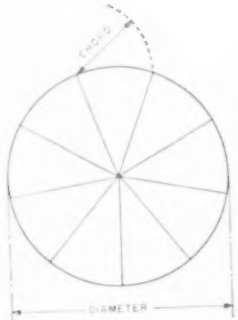
Lengths of Chords for Dividing Circles Into Equal Parts



If the diameter is in even feet or even inches, the chords can be found directly from the tables below. If the diameter is in feet and inches, add the chord corresponding to the number of even feet to the chord corresponding to the number of even inches in the diameter. For example, find the chord used for spacing the circumference of a circle 6 feet 2 inches in diameter into nine equal spaces.

From table with diameter in feet, chord for 9 spaces, 6 feet ..... = 24.6254
From table with diameter in inches, chord for 9 spaces, 2 inches = .6840

Therefore chord for 6 feet, 2 inches, 9 spaces ..... = 25.3094

The table for additional fractions is used in the same manner. For 6 spaces, the chord is equal to the radius.

Length of Chord When Diameter is

No. of spaces	1 ft.	2 ft.	3 ft.	4 ft.	5 ft.	6 ft.	7 ft.	8 ft.	9 ft.	10 ft.
3	10.3923	20.7846	31.1769	41.5692	51.9615	62.3538	72.7461	83.1384	93.5307	103.9230
4	8.4853	16.9706	25.4558	33.9411	42.4264	50.9117	59.3970	67.8822	76.3675	84.8528
5	7.0534	14.1068	21.1603	28.2137	35.2671	42.3205	49.3740	56.4274	63.4808	70.5342
7	5.2066	10.4132	15.6198	20.8264	26.0330	31.2396	36.4462	41.6523	46.8594	52.0660
8	4.5922	9.1844	13.7766	18.3688	22.9610	27.5532	32.1454	36.7376	41.3298	45.9220
9	4.1042	8.2085	12.3127	16.4170	20.5212	24.6254	28.7297	32.8339	36.9382	41.0424

Length of Chord When Diameter is

No. of spaces	1 in.	2 in.	3 in.	4 in.	5 in.	6 in.	7 in.	8 in.	9 in.	10 in.	11 in.
3	.8660	1.7321	2.5981	3.4641	4.3301	5.1962	6.0622	6.9282	7.7942	8.6603	9.5263
4	.7071	1.4142	2.1213	2.8284	3.5355	4.2426	4.9497	5.6569	6.3640	7.0711	7.7782
5	.5878	1.1756	1.7634	2.3511	2.9389	3.5267	4.1145	4.7023	5.2901	5.8779	6.4656
7	.4339	.8678	1.3017	1.7355	2.1694	2.6033	3.0372	3.4711	3.9050	4.3388	4.7727
8	.3827	.7654	1.1481	1.5307	1.9134	2.2961	2.6788	3.0615	3.4442	3.8268	4.2095
9	.3420	.6840	1.0261	1.3681	1.7101	2.0521	2.3941	2.7362	3.1782	3.4202	3.7622

Length of Chord To Be Added for Each Additional Fraction of

No. of spaces	1/8 in.	1/4 in.	3/8 in.	1/2 in.	5/8 in.	3/4 in.	7/8 in.
3	.1083	.2165	.3248	.4330	.5413	.6495	.7578
4	.0884	.1768	.2652	.3536	.4419	.5303	.6187
5	.0735	.1469	.2204	.2939	.3674	.4408	.5143
7	.0542	.1085	.1627	.2169	.2712	.3254	.3796
8	.0478	.0957	.1435	.1913	.2392	.2870	.3348
9	.0427	.0855	.1283	.1710	.2138	.2565	.2993

Length of Chord When Diameter is

No. of spaces	1 ft.	2 ft.	3 ft.	4 ft.	5 ft.	6 ft.	7 ft.	8 ft.	9 ft.	10 ft.
11	3.3303	6.7616	10.1424	13.5232	16.9040	20.2847	23.6655	27.0463	30.4271	33.8079
12	3.1058	6.2117	9.3175	12.4233	15.5291	18.6350	21.7408	24.8466	27.9525	31.0583
13	2.8718	5.7436	8.6154	11.4872	14.3589	17.2307	20.1025	22.9743	25.8461	28.7179
14	2.7602	5.3405	8.0107	10.6310	13.3512	16.0215	18.6917	21.3620	24.0322	26.7025
15	2.4949	4.9899	7.4848	9.9798	12.4747	14.9696	17.4646	19.9595	22.4545	24.9494
16	2.3411	4.6822	7.0233	9.3643	11.7054	14.0465	16.3876	18.7287	21.0698	23.4108
17	2.2050	4.4100	6.6150	8.8200	11.0250	13.2300	15.4350	17.6400	19.8449	22.0499
18	2.0838	4.1676	6.2513	8.3351	10.4189	12.5027	14.5864	16.6702	18.7540	20.8378
19	1.9751	3.9503	5.9254	7.9005	9.8757	11.8508	13.8259	15.8011	17.7762	19.7513
20	1.8772	3.7544	5.6316	7.5039	9.3861	11.2633	13.1405	15.0177	16.8949	18.7721
21	1.7885	3.5770	5.3655	7.1540	8.9425	10.7310	12.5195	14.3081	16.0966	17.8851
22	1.7078	3.4156	5.1233	6.8311	8.5389	10.2467	11.9544	13.6622	15.3700	17.0778
23	1.6340	3.2680	4.9020	6.5360	8.1700	9.8040	11.4380	13.0720	14.7060	16.3400
24	1.5663	3.1326	4.6989	6.2653	7.8316	9.3979	10.9642	12.5305	14.0968	15.6631
25	1.5040	3.0080	4.5120	6.0160	7.5200	9.0240	10.5280	12.0320	13.5360	15.0400

Length of Chord When Diameter is

No. of spaces	1 in.	2 in.	3 in.	4 in.	5 in.	6 in.	7 in.	8 in.	9 in.	10 in.	11 in.
10	.3090	.6170	.9271	1.2361	1.5451	1.8541	2.1631	2.4721	2.7812	3.0902	3.9992
11	.2817	.5635	.8452	1.1269	1.4087	1.6904	1.9721	2.3539	2.6356	2.8173	3.0991
12	.2588	.5176	.7765	1.0353	1.2941	1.5529	1.8117	2.0706	2.3294	2.5882	2.8470
13	.2393	.4786	.7179	.9573	1.1966	1.4359	1.6752	1.9145	2.1538	2.3932	2.6325
14	.2225	.4450	.6676	.8901	1.1126	1.3351	1.5576	1.7802	2.0027	2.2252	2.4477
15	.2079	.4158	.6237	.8316	1.0396	1.2475	1.4554	1.6633	1.8712	2.0791	2.2870
16	.1951	.3902	.5853	.7804	.9755	1.1705	1.3656	1.5607	1.7558	1.9509	2.1460
17	.1837	.3675	.5512	.7350	.9187	1.1025	1.2362	1.4700	1.6537	1.8375	2.0212
18	.1736	.3473	.5209	.6946	.8682	1.0419	1.2155	1.3892	1.5628	1.7365	1.9101
19	.1646	.3292	.4938	.6584	.8230	.9876	1.1522	1.3168	1.4814	1.6459	1.8105
20	.1564	.3129	.4693	.6257	.7822	.9336	1.0950	1.2515	1.4079	1.5643	1.7208
21	.1490	.2981	.4471	.5962	.7452	.8943	1.0433	1.1923	1.3414	1.4904	1.6395
22	.1423	.2846	.4269	.5693	.7116	.8539	.9962	1.1385	1.2808	1.4231	1.5655
23	.1362	.2723	.4085	.5447	.6808	.8170	.9532	1.0893	1.2255	1.3617	1.4978
24	.1395	.2611	.3916	.5221	.6526	.7832	.9137	1.0442	1.1747	1.3053	1.4358
25	.1253	.2507	.3760	.5013	.6267	.7520	.8773	1.0027	1.1280	1.2533	1.3787

Length of Chord To Be Added for Each Additional Fraction of

No. of spaces	1/8 in.	1/4 in.	3/8 in.	1/2 in.	5/8 in.	3/4 in.	7/8 in.
10	.0386	.0773	.1159	.1545	.1931	.2318	.2704
11	.0352	.0704	.1056	.1409	.1761	.2113	.2465
12	.0323	.0657	.0981	.1294	.1618	.1941	.2265
13	.0299	.0598	.0897	.1197	.1496	.1795	.2094
14	.0278	.0556	.0834	.1113	.1391	.1669	.1947
15	.0260	.0520	.0780	.1040	.1299	.1559	.1819
16	.0244	.0488	.0732	.0975	.1219	.1463	.1707
17	.0229	.0459	.0689	.0919	.1148	.1378	.1608

Length of Chord To Be Added for Each Additional Fraction of

No. of spaces	1/8 in.	1/4 in.	3/8 in.	1/2 in.	5/8 in.	3/4 in.	7/8 in.
18	.0217	.0434	.0651	.0868	.1085	.1302	.1519
19	.0206	.0411	.0617	.0823	.1029	.1234	.1440
20	.0196	.0391	.0587	.0782	.0978	.1173	.1369
21	.0186	.0373	.0559	.0745	.0932	.1118	.1304
22	.0177	.0356	.0534	.0712	.0889	.1067	.1245
23	.0170	.0340	.0511	.0681	.0851	.1021	.1191
24	.0163	.0326	.0489	.0653	.0816	.0979	.1142
25	.0157	.0313	.0470	.0627	.0783	.0940	.1097

Lengths of Chords for Dividing Circles Into Equal Parts

Length of Chord When Diameter is

No. of spaces	1 ft.	2 ft.	3 ft.	4 ft.	5 ft.	6 ft.	7 ft.	8 ft.	9 ft.	10 ft.
26	1.4464	2.8929	4.3393	5.7858	7.2322	8.6785	10.1250	11.5714	13.0179	14.4643
27	1.3931	2.7862	4.1793	5.5725	6.9656	8.3587	9.7518	11.1449	12.5380	13.9311
28	1.3435	2.6871	4.0307	5.3743	6.7179	8.0614	9.4050	10.7486	12.0922	13.4357
29	1.2974	2.5949	3.8923	5.1897	6.4871	7.7846	9.0820	10.3794	11.6768	12.9742
30	1.2543	2.5087	3.7630	5.0174	6.2717	7.5260	8.7804	10.0347	11.2891	12.5434
31	1.2140	2.4280	3.6421	4.8561	6.0701	7.2841	8.4981	9.7122	10.9262	12.1402
32	1.1762	2.3524	3.5286	4.7048	5.8810	7.0572	8.2334	9.4096	10.5858	11.7621
33	1.1407	2.2813	3.4220	4.5627	5.7034	6.8440	7.9847	9.1254	10.0660	11.4067
34	1.1072	2.2144	3.3217	4.4289	5.5361	6.6433	7.7505	8.8578	9.9650	11.0722
35	1.0757	2.1513	3.2270	4.3027	5.3784	6.4540	7.5297	8.6054	9.6810	10.7567
36	1.0459	2.0917	3.1376	4.1835	5.2293	6.2752	7.3211	8.3669	9.4128	10.4587
37	1.0177	2.0353	3.0530	4.0707	5.0883	6.1060	7.1237	8.1414	9.1590	10.1767
38	.9910	1.9819	2.9729	3.9638	4.9548	5.9457	6.9367	7.9276	8.9186	9.9095
39	.9656	1.9312	2.8968	3.8624	4.8280	5.7936	6.7592	7.7248	8.6904	9.6560
40	.9415	1.8830	2.8245	3.7660	4.7075	5.6491	6.5906	7.5321	8.4736	9.4151
41	.9186	1.8372	2.7558	3.6744	4.5930	5.5115	6.4301	7.3487	8.2673	9.1859

Length of Chord When Diameter is

No. of spaces	1 in.	2 in.	3 in.	4 in.	5 in.	6 in.	7 in.	8 in.	9 in.	10 in.	11 in.
26	.1205	.2411	.3616	.4821	.6027	.7232	.8438	.9643	1.0848	1.2054	1.3259
27	.1161	.2322	.3483	.4644	.5805	.6966	.8127	.9287	1.0448	1.1609	1.2770
28	.1120	.2239	.3359	.4480	.5598	.6718	.7838	.8957	1.0077	1.1196	1.2316
29	.1081	.2162	.3244	.4324	.5406	.6487	.7568	.8650	.9731	1.0812	1.1893
30	.1045	.2091	.3136	.4181	.5226	.6272	.7317	.8362	.9408	1.0453	1.1498
31	.1012	.2023	.3035	.4047	.5058	.6070	.7082	.8093	.9105	1.0117	1.1129
32	.0980	.1960	.2941	.3921	.4901	.5881	.6861	.7841	.8822	.9802	1.0782
33	.0951	.1901	.2852	.3802	.4753	.5703	.6654	.7604	.8555	.9506	1.0456
34	.0923	.1845	.2768	.3691	.4613	.5536	.6459	.7381	.8304	.9227	1.0150
35	.0896	.1793	.2689	.3586	.4482	.5378	.6275	.7171	.8068	.8964	.9860
36	.0872	.1743	.2615	.3486	.4358	.5229	.6101	.6972	.7844	.8716	.9587
37	.0848	.1696	.2544	.3392	.4240	.5088	.5936	.6784	.7633	.8481	.9329
38	.0826	.1651	.2477	.3303	.4129	.4955	.5781	.6606	.7432	.8258	.9084
39	.0805	.1609	.2414	.3219	.4023	.4828	.5633	.6437	.7242	.8047	.8851
40	.0785	.1569	.2354	.3138	.3923	.4708	.5492	.6277	.7061	.7846	.8631
41	.0765	.1531	.2296	.3062	.3827	.4593	.5358	.6124	.6889	.7655	.8420

Length of Chord to be Added for Each Additional Fraction of

No. of spaces	1/8 in.	1/4 in.	3/8 in.	1/2 in.	5/8 in.	3/4 in.	7/8 in.	No. of spaces	1/8 in.	1/4 in.	3/8 in.	1/2 in.	5/8 in.	3/4 in.	7/8 in.
26	.0151	.0301	.0452	.0603	.0753	.0904	.1055	34	.0115	.0231	.0346	.0461	.0577	.0692	.0807
27	.0144	.0288	.0432	.0575	.0719	.0863	.1007	35	.0112	.0224	.0336	.0448	.0560	.0672	.0784
28	.0140	.0280	.0420	.0560	.0700	.0840	.0980	36	.0109	.0218	.0327	.0436	.0545	.0654	.0763
29	.0135	.0270	.0405	.0541	.0676	.0811	.0946	37	.0106	.0212	.0318	.0424	.0532	.0636	.0742
30	.0131	.0261	.0392	.0523	.0653	.0784	.0915	38	.0103	.0206	.0310	.0413	.0516	.0619	.0723
31	.0126	.0253	.0379	.0506	.0632	.0759	.0885	39	.0101	.0201	.0302	.0402	.0503	.0603	.0704
32	.0123	.0245	.0368	.0490	.0613	.0735	.0858	40	.0098	.0196	.0294	.0392	.0490	.0588	.0687
33	.0119	.0238	.0356	.0475	.0594	.0713	.0832	41	.0096	.0191	.0287	.0383	.0478	.0574	.0670

Length of Chord When Diameter is

No. of spaces	1 ft.	2 ft.	3 ft.	4 ft.	5 ft.	6 ft.	7 ft.	8 ft.	9 ft.	10 ft.
42	.8968	1.7935	2.6903	3.5870	4.4838	5.3806	6.2773	7.1741	8.0709	8.9676
43	.8759	1.7519	2.6278	3.5038	4.3797	5.2557	6.1316	7.0075	7.8835	8.7594
44	.8561	1.7121	2.5682	3.4243	4.2803	5.1364	5.9925	6.8486	7.7046	8.5607
45	.8371	1.6742	2.5112	3.3483	4.1854	5.0225	5.8595	6.6966	7.5337	8.3708
46	.8189	1.6378	2.4567	3.2756	4.0945	4.9134	5.7324	6.5513	7.3702	8.1891
47	.8015	1.6030	2.4045	3.2060	4.0076	4.8091	5.6106	6.4121	7.2136	8.0151
48	.7848	1.5697	2.3545	3.1393	3.9242	4.7090	5.4939	6.2787	7.0635	7.8484
49	.7688	1.5377	2.3065	3.0754	3.8442	4.6131	5.3819	6.1507	6.9196	7.6884
50	.7535	1.5070	2.2605	3.0139	3.7674	4.5209	5.2744	6.0279	6.7814	7.5349
51	.7387	1.4774	2.2162	2.9549	3.6937	4.4324	5.1711	5.9098	6.6486	7.3873
52	.7245	1.4491	2.1736	2.8982	3.6227	4.3472	5.0718	5.7963	6.5209	7.2454
53	.7109	1.4218	2.1327	2.8435	3.5544	4.2653	4.9762	5.6871	6.3980	7.1089
54	.6977	1.3955	2.0932	2.7910	3.4887	4.1864	4.8842	5.5819	6.2796	6.9774
55	.6851	1.3701	2.0552	2.7403	3.4253	4.1104	4.7955	5.4805	6.1656	6.8507
56	.6728	1.3457	2.0185	2.6914	3.3642	4.0731	4.7099	5.3828	6.0556	6.7284
57	.6611	1.3221	1.9382	2.6442	3.3053	3.9663	4.6274	5.2884	5.9495	6.6105

Length of Chord When Diameter is

No. of spaces	1 in.	2 in.	3 in.	4 in.	5 in.	6 in.	7 in.	8 in.	9 in.	10 in.	11 in.
42	.0747	.1495	.2242	.2989	.3736	.4484	.5231	.5978	.6726	.7473	.8220
43	.0730	.1460	.2190	.2920	.3650	.4380	.5110	.5840	.6570	.7300	.8029
44	.0713	.1427	.2140	.2854	.3567	.4280	.4993	.5707	.6421	.7134	.7847
45	.0698	.1395	.2093	.2790	.3488	.4185	.4883	.5581	.6278	.6976	.7673
46	.0682	.1365	.2047	.2730	.3412	.4095	.4777	.5459	.6142	.6824	.7507
47	.0668	.1336	.2004	.2672	.3340	.4008	.4675	.5343	.6011	.6679	.7347
48	.0654	.1308	.1962	.2616	.3270	.3924	.4578	.5232	.5886	.6540	.7194
49	.0641	.1281	.1922	.2563	.3204	.3844	.4485	.5126	.5766	.6407	.7048
50	.0628	.1256	.1884	.2512	.3140	.3767	.4395	.5023	.5651	.6279	.6907
51	.0616	.1231	.1847	.2462	.3078	.3694	.4309	.4925	.5540	.6156	.6772
52	.0604	.1208	.1811	.2415	.3019	.3623	.4226	.4830	.5434	.6038	.6642
53	.0592	.1184	.1777	.2370	.2962	.3554	.4147	.4739	.5332	.5924	.6516
54	.0581	.1163	.1744	.2326	.2907	.3489	.4070	.4652	.5233	.5814	.6396
55	.0571	.1142	.1713	.2284	.2854	.3425	.3996	.4567	.5138	.5709	.6280
56	.0561	.1121	.1682	.2243	.2804	.3364	.3925	.4486	.5046	.5607	.6168
57	.0551	.1102	.1653	.2204	.2754	.3305	.3856	.4407	.4958	.5509	.6060

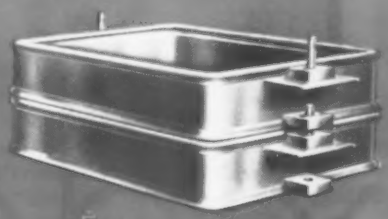
Length of Chord to be Added for Each Additional Fraction of

No. of spaces	1/8 in.	1/4 in.	3/8 in.	1/2 in.	5/8 in.	3/4 in.	7/8 in.
42	.0093	.0187	.0280	.0374	.0467	.0560	.0654
43	.0091	.0182	.0274	.0365	.0456	.0547	.0639
44	.0089	.0178	.0268	.0357	.0446	.0535	.0624
45	.0087	.0174	.0262	.0349	.0436	.0523	.0610
46	.0085	.0171	.0256	.0341	.0427	.0512	.0597
47	.0083	.0167	.0250	.0334	.0417	.0501	.0584
48	.0082	.0164	.0245	.0327	.0409	.0491	.0572
49	.0080	.0160	.0240	.0320	.0400	.0481	.0561

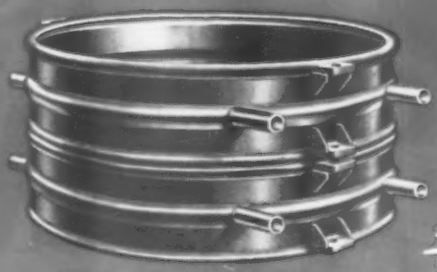
Length of Chord to be Added for Each Additional Fraction of

No. of spaces	1/8 in.	1/4 in.	3/8 in.	1/2 in.	5/8 in.	3/4 in.	7/8 in.
50	.0078	.0157	.0235	.0314	.0392	.0471	.0549
51	.0077	.0154	.0231	.0308	.0385	.0462	.0539
52	.0075	.0151	.0226	.0302	.0377	.0453	.0528
53	.0074	.0148	.0222	.0296	.0370	.0444	.0518
54	.0073	.0145	.0218	.0291	.0363	.0436	.0509
55	.0071	.0143	.0214	.0285	.0357	.0428	.0500
56	.0070	.0140	.0210	.0280	.0350	.0421	.0491
57	.0069	.0138	.0207	.0275	.0344	.0413	.0482

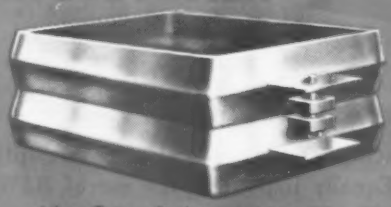
LOW FIRST COST
LOW OPERATING COST



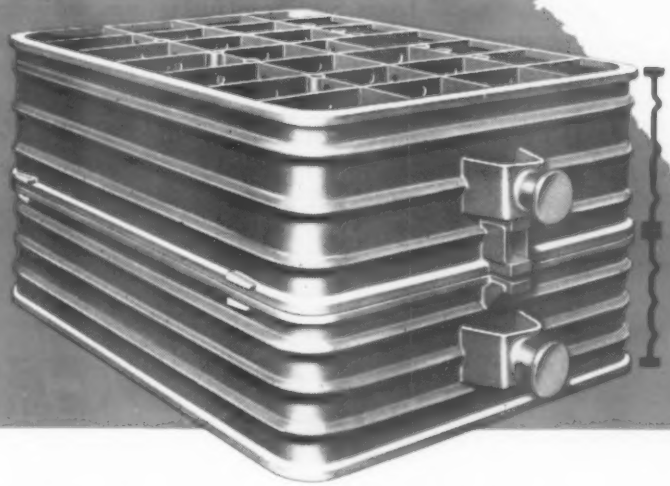
6A—One man Flask for stacking.



10B—Round two man Flask.



4A—Extra light weight, easy shake out.



Divide the greater number of production hours given by a Shanafelt Flask into its low original cost, and you'll get a very happy answer. Shanafelt Steel Flask equipment has been proving its economy in American foundries for over 26 years. Check it for yourself. When you need new Flasks, just remember — SHANAFELT, CANTON, OHIO — and send us your inquiry. You'll like the price and you'll like the Flasks.

The combination of corrugated sidewalls and welded flanges makes a Flask with exceptional strength and rigidity. The size of the flanges and the thickness of the sidewalls are varied to suit the requirements. The Flask illustrated is 36" x 50" — 14" Cope — 12" Drag. Weight 1010# per set.

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ANNUAL BRITISH FOUNDRY CONFERENCE

Is International In Scope

By VINCENT DELPORT
European Manager
THE FOUNDRY

AN INTERNATIONAL touch was given to the 47th annual conference of the Institute of British Foundrymen by the presence of delegates of member associations of the International Committee of Foundry Technical Associations. The conference was held June 7-9, at Buxton. At Amsterdam last year, it was decided that as no official international foundry congress would be held in 1950, the meetings of the International Committee and of its subcommittees would take place at the occasion of the British foundry convention. As a result, there was an unusual attendance of visitors from Belgium, France, Italy, the Netherlands, Sweden and the United States. Foundrymen from Australia, South Africa and Rhodesia also were present.

N. P. Newman, IBF president, opened the conference with the annual business meeting of the institute, at which the report for 1949-50 was presented. This disclosed that membership of the institute had increased from 4437 at April 30, 1949 to 4588 at April 30, 1950. The report of the technical council also was presented. It was announced that seven subcommittees had completed their work and been dissolved during the year. These were the subcommittees in charge of: The Atlas of Defects in Castings, Stripping Temperature, Solidification Rate of Cast Iron, Reclamation of Iron Castings, Salvaging of Nonferrous castings, Cupola Raw Materials, and Standardization of Molding Box Equipment. The following eight subcommittees continue their activities: Soundness of Iron Castings, Ingates, Flow of Metal, Synthetic Resins, Heat Treatment of Gray Cast Iron, Internal Stress, Pyrometric Method of Investigating Rate of Solidification, and Molding Boxes.

The Oliver Stubbs gold medal was awarded to J. Arnot, in recognition of outstanding services to the institute by his work in presenting several valuable papers of a particularly high standard and by his active participation in the work of the technical council and technical committees.

The E. J. Fox gold medal was awarded to S. H. Russell, past president, in recognition of the great contributions he has made in the technical education, research organization, and administrative fields of the industry over a long period of service. Mr. Russell was the leader of the productivity team for gray iron foundries which visited the United States this spring.

Two Meritorious medals were awarded this year. One to T. R. Walker, the other to A. S. Wall for the outstanding services which they have rendered to the institute as honorary secretaries of two branches. Mr. Wall has been honorary secretary of the Wales and Monmouth branch since 1942, while Mr. Walker has just relinquished the honorary secretaryship of the Sheffield branch after almost 23 years' service.

The British foundry medal and award for 1950 was awarded to A. R. Martin, for his paper "Some Notable Aluminum Alloy Castings." He is chief metallurgist at Northern Aluminum Co.

Diplomas for papers read before branches during the session were awarded to: E. S. Renshaw and S. J. Sargood for the paper "Some Modifications in Cupola Design," read before the London branch; W. Wilson and A. Talbot, for "Casting a Large Pulley Wheel in Aluminum," read before the London and Bristol branches; J. Caven and H. W. Keeble, for "Making Special Duty Castings in Aluminum Alloy," read before the Birmingham branch; L. W. Bolton, for the paper (of which he is joint author) "Modernizing an Iron Foundry," read before the London branch.

Certificates of honorary life membership were presented to John Cameron, past president of the institute and a member since 1917, and Joshua Hogg, past president of the Lancashire branch who joined the institute in 1912.

Officers for the year 1950-51 were elected as follows: President, J. J. Sheehan, managing director of the Coneygre Foundry Ltd., Tipton, Staffs; senior vice president, Colin Gresty, general foundry manager and chief metallurgist, North Eastern Marine Engineering Co., Wallsend-on-Tyne and Sunderland; junior vice president, C. J. Dadswell, director, English Steel Corp., Sheffield.

The following five members were elected to the council for two years: Dr. A. B. Everest, Mond Nickel Co., London; R. L. Handley, president, Lancashire branch; Barrington Hooper, managing director, Industrial Newspapers Ltd.; A. E. Peace, chairman of the institute's technical council; R. C. Shepherd, chairman of the Ingates subcommittee.

Before closing the meeting, chairman N. P. Newman proposed that a

J. J. SHEEHAN
President

COLIN GRESTY
Senior Vice President

C. J. DADSWELL
Junior Vice President

telegram of greetings be sent to the American Foundrymen's Society and he announced that Mrs. William W. Maloney, wife of the secretary of the AFS was present. The proposal to send the cable was endorsed with acclamation.

J. J. Sheehan, newly elected president, then delivered his presidential address, "A Way of Living." In this address he took a philosophical view of the full purpose and aims of the Institute of British Foundrymen. Recalling that the institute had been founded with a definite technical and scientific objective, which throughout the years had been adequately achieved, he stressed that, thanks to its constitution and type of membership, the institute also fulfilled a definite function as a social institution, and helped to make "a way of living."

In an industrial civilization, of which the foundry industry partakes, living in towns and cities is somewhat strenuous. There are, however, many compensations, and escape can be found in participation in the activities of the professional and technical institutions; the activities of the Institute of British Foundrymen seem to be especially designed for that purpose. The institute combines the two concepts of "knowledge of oneself through creative thought and full development of the mind," and "knowledge of one another through friendly association." The speaker then reviewed briefly the constitution of the institute, of its council, committees and branches. "Its structure is sound and balanced," he stated, "and may best be likened to a healthy tree, well rooted, with a substantial body and flourishing in its branches." He said that it was difficult to exaggerate the importance of the branches which, apart from their purpose in discussing technical matters, gave the opportunity to widen the circle of friends.

He pointed out the importance of presenting and discussing papers, which helps to eliminate shyness and enhances confidence and courage. Later, participation in committee work affords excellent training for all activities of the institute. He referred to the immediate success of the foundry foremen's training course, which had been started in 1948, and had brought together foremen, managers and executives to discuss common problems and understand respective difficulties. Mr. Sheehan then referred to the student's sections of the institute, which "give our very junior members an opportunity of starting their friendships early in life . . . and are of most benefit in forming disposition and character."

Finally, the president referred to the opportunities afforded by the annual conferences to strengthen the ties of friendship already formed, and create new ones, extending to the international field.

The Edward Williams lecture was delivered by Sir Andrew McCance, his subject being "Gases in Steel." Sir Andrew who, throughout his career, has devoted much of his time to metallurgical research and particularly to the study of gases in steel, reviewed the subject, dealing with origin and causes of absorption of gases in steel, defects caused by these gases when metal solidifies, analysis and detection of gases, and methods of removal.

During the conference a number of social events had been arranged, including a reception by the mayor of Buxton, and the annual banquet. Approximately 500 members and guests were present.

On the last day of the conference works visits were arranged to the following: Butterley Co., Ripley, general engineering, jobbing and mechanized foundry. Markham & Co., Chesterfield, brass, ironfounders. Staveley Iron & Chemical Co., Staveley, blast furnaces, chemical works, spun pipe plants, and general foundries. Sheepbridge Engineering Co., Chesterfield, centrifugal castings for cylinder liners and piston rings, and alloy sand castings. Hadfields Ltd., East Hecla works, Sheffield, large steel foundries, specializing in manganese steel castings. Billington & Newton Ltd., Stoke-on-Trent, nonferrous founders. T. M. Birkett & Sons Ltd., Stoke-on-Trent, nonferrous founders and engineers. A special program also had been arranged for the ladies.

In the course of the proceedings, Dr. J. G. Pearce, director of the British Cast Iron Research Association, gave details of the National Foundry College, at Wolverhamton opened two years ago to succeed the British Foundry School which was started at Birmingham before the war. Students from foreign countries may follow the courses at the new college.

At the meeting of the International Committee of Foundry Technical Associations, F. W. E. Spies, president of the Dutch Foundry Technical Association unanimously was elected president for 1951. Italy was designated

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Awarded the Oliver Stubbs gold medal, Mr. Arnot is chief metallurgist, G. & J. Weir Ltd., Glasgow, Scotland. He studied at the Royal Technical College and after a short time in a consulting metallurgical laboratory, he became connected with G. & J. Weir in 1913. He joined the IBF in 1920, was a member of the technical council for many years, and has taken part in co-operative investigations of its subcommittees. He is a member of the Council of the Institute of Metals and many other metallurgical, chemical and engineering societies.

J. ARNOT

Awarded the E. J. Fox gold medal, Mr. Russell is associated with S. Russell & Sons Ltd., Leicester, England, which was started by his grandfather in 1864. He entered the firm as an apprentice and following 4 years as coremaker and molder, spent a year at Birmingham University. In 1910 he took over supervision of the foundry under his uncle, and since 1916 has been a partner, supervising all foundry work. Mr. Russell was president of the IBF in 1928 and was awarded the Oliver Stubbs gold medal in 1942. He is chairman of the finance committee of the Joint Iron Council.

S. H. RUSSELL

Recipient of the Meritorious Services Medal, Mr. Walker is chief chemist, English Steel Corp. Ltd., Sheffield, England. He was educated at Cambridge and joined the Sheffield staff of Cammell, Laird & Co. in 1915 where he took charge of the chemical laboratories. In 1930 when the company joined Vickers - Armstrongs Ltd. to form the English Steel Corp., he was appointed chief chemist of the new company. Mr. Walker has been honorary secretary - treasurer and president of the Sheffield branch of the IBF. He has published a number of papers on foundry materials, fuel and refractories and a book on foundry sands. Mr. Walker is president of the Foundry Trades Technical Societies.

T. R. WALKER

to nominate the vice president. Tom Makemson was re-elected honorary secretary by acclamation. The calendar of future international congresses tentatively approved at the Amsterdam meeting last year was confirmed. The dates and venues are as follows: 1951, Belgium; 1952, United States; 1953, France; 1954, Italy, and 1955, Great Britain.

Two associations were accepted as members of the international committee: The Verein Deutscher Giessereifacheute, the technical association of Western Germany, and the Foundry Division of the Swedish Federation of Mechanical and Engineering Industries.

Hiram Brown, chief metallurgist, Solar Aircraft Company, Des Moines, Iowa, contributed the AFS exchange paper. Subject of the paper was "Nonferrous Investment Casting." It was presented by Dr. A. B. Everest. (Mr. Brown's paper was published under the title "Modern Practice in Investment Casting" in THE FOUNDRY, November and December, 1949, and January, 1950.)

Dr. O. R. J. Lee, formerly head of melting and casting section, British Non Ferrous Metal Research Association, and B. W. Peck, research metallurgist, Magnesium Elektron Ltd., Manchester, contributed a paper on "Sand Cast Test Bars for Copper Base Alloys." As the result of a recently recommended wedge type test bar by the British Standards Institution, the authors describe work done to determine the mechanical properties obtainable from these test pieces when prepared from high quality melts of the following copper-base alloys: 88-8-4 gunmetal, 83-7-5-5 leaded gunmetal, 89.65-10-0.35 phosphor bronze and 90-10 aluminum bronze. They conclude that the wedge bar is capable of giving results above the specification limits in all alloys studied, provided degassed metal is employed. For foundry control purposes, they claim that the D.T.D. test bar recommended by the IBF appears more sensitive to changes in metal quality than the wedge bar.

During the discussion period the authors stated that the test bars were cast in dry sand molds; that they were poured at the top, but tilted in some cases, and that the melts were of 60 to 70 lbs. They said that in the work described there was a slight correlation between the density measurements and soundness, and that the results were reproducible. The wedge bar for aluminum bronze in preference to the D.T.D. bar was recommended. They agreed that, when casting in chills, the D.T.D. bar gave better properties than the wedge bar and expressed the opinion that the IBF bar, in most cases did not give a good indication of metal quality. In their opinion there is no hope of producing a test bar which would show if a casting were pressure-tight; the objective was to find a test bar which would indicate melt quality.

Casting Pure Copper

"Some Experiments in Sand Casting of Conductivity Copper," was the title of a contribution by W. H. Glaisher, research investigator, British Iron & Steel Research Association, formerly with the British Non-Ferrous Research Association. The author described experiments on the effects of various degassing and deoxidation treatments on the properties of sand cast test bars made from melts of electrolytic copper melted under charcoal covers. These experiments showed that bars of high density, electrical conductivity and mechanical properties may be made by melting under charcoal, degassing with marble chips or manganese ore, and deoxidizing with sufficient phosphor-copper to leave a residual phosphorus content of 0.01-0.02 per cent. Deoxidation with magnesium or calcium is not recommended. In the discussion, one speaker said that some oxygen was needed in copper, and he suggested the use of wire bars. Another speaker said that he had tried wire bars but had found that conductivity had dropped by 5 or 10 per cent, due no doubt to small amounts of impurities. Mr. Peck, who presented the paper in the author's absence, said that he thought oxygen did not help.

(To be concluded next month)

Recipient of the Meritorious Services medal, Mr. Wall is associated with Stanton Iron Co., Nottingham, England, as pig iron representative for South Wales and western England. He served his apprenticeship at Atlas Foundry, Cardiff, Wales, and subsequently gained experience with various firms in the Midlands and West Wales, including Pembroke Dockyard. He returned to Cardiff in 1916 and joined Tubal Cain Foundry. From 1922 until 1935, when he joined Stanton Iron Co., he was engaged in sales of foundry equipment. Mr. Wall joined the institute in 1929 and since 1942 has been honorary secretary of the Wales and Monmouth Branch.

A. S. WALL

Ferrous Alloys

(Continued from page 97)

if the temperature is high enough.

Returning to our blast furnace we find, in fact, gas and temperature conditions successively below the top of the stack favoring the reactions,

$$CO + Fe_2O_3 = Fe_3O_4 + CO_2,$$
$$CO + Fe_3O_4 = 3FeO + CO_2,$$

and

$$CO + FeO = Fe + CO_2.$$

As a result of the series, metallic iron in the solid state makes its appearance in the charge. Below the A_1 point, the reaction of C and Fe is slow, owing to a low migratory rate of carbon into iron from the surface where it might be absorbed, but above A_3, when the iron is in the gamma state, the reaction

$$2CO + 3Fe = Fe_3C + CO_2$$

proceeds energetically, the carbon migrating inward into the iron particles.

The system we are considering is one of three components, Fe, C, and O, and two phases, solid and gas, when above the critical point A_1. The solid would be of two phases below the critical point if it contained carbon. Gibbs' phase rule then teaches us that in the former case the number of degrees of freedom is

$$3 + 2 - 2 = 3.$$

That is, we can assign arbitrary values to three variables before the composition of the system is determined. If we set a pressure and temperature, two degrees of freedom are used up. If we set a ratio of CO to CO_2, we in effect determine the carbon (or oxygen) content of the gas phase, and the composition of the gas and of the solid is completely determined. The iron then will contain a given amount of carbon. The equilibrium of CO-CO_2 mixtures with austenite of various carbon contents has been studied by several observers, and the results are summarized in Fig. 2.

Carbon-oxygen-gamma iron — Fig. 2 has great utility in any problem where a reaction between CO-CO_2 mixtures and solid steel is involved. Note that it is in the nature of an addition to Fig. 1 of this chapter, filling in data above the so-called Fe-FeO equilibrium line.

Solid iron can be carburized under the most favorable conditions up to about 1.75 per cent C before melting. For this to occur, the CO-CO_2 mixture must be in equilibrium with cementite, and the temperature must be 1130° C, the eutectic melting point.

When the carburized iron of this

or a lesser carbon content melts, the solubility for carbon suddenly increases, and—to the extent that ample contact between melt and coke exists—the carbon rises rapidly. Indeed, gases in equilibrium with coke should raise the carbon just as much.

The form in which carbon exists in liquid iron is not clearly understood. Cesaro concluded that it was present as cementite molecules, based on the form of the solidus and liquidus curves of hypoeutectoid metal. This view has now found considerable acceptance, although the possibility of dissociation, according to the reaction

$$Fe_3C = 3Fe + C,$$

cannot be excluded. For low concentrations of carbon, the ratio of atomic carbon to molecular cementite should be constant, but we do not know enough about the constants for free energy of formation of cementite dissolved in iron to set a value. For a more concentrated solution when Fe is no longer substantially constant, the proportionality of C to Fe_3C would fail, and this ratio would increase rapidly with increasing total carbon. Such a state is definitely reached in the carbon range for cast irons.

Obtain Carbon Content Readily

It is quite easy to reach temperatures at which the iron in contact with carbon will become hypereutectoid in composition, and indeed carbon contents above 6 2/3 per cent, that is, that of cementite, can be had without much difficulty. Just what is in solution in such cases may be left unanswered. The hypereutectoid part of the iron-carbon system, especially above the eutectic temperature, has not yet been explored adequately.

As the liquid iron from the blast furnace cools in the ladle or in pigs, the solubility of carbon decreases, and some carbon must be rejected. Actually kish, which consists of graphite flakes, floats away.

Solid cementite-solid graphite-liquid iron—Regardless of what was in solution, it is natural that what escapes should be largely graphite. The solubility lines of cementite and graphite in solid iron would, if projected upward, intersect somewhat above 1200° C. This indicates that solid graphite and solid cementite are in equilibrium at that temperature. One would infer, therefore, that the hypereutectic liquidus lines of the stable system should intersect at that temperature, a point not so far considered in any discussions of this region of the diagram known to the author. Above 1200° C, cementite is stable; below this, graphite.

Now solid cementite can exist at about 1200° C only in equilibrium with a saturated liquid solution in iron. Any cementite rejected above 1200° C might remain as the solid, but when cooled below that temperature it would quickly decompose into the elements. Graphite should float out. The practical result is that pig iron reduces its carbon during freezing to a value but little above the eutectic concentration.

We have not yet considered the effect of silicon, but the reader may as well be informed here as later that silicon lowers the carbon content of the eutectic so that the total carbon of pig iron is somewhat related to its silicon content.

Having now spent so much time showing how carbon enters the product of the blast furnace, we should tell the reader how all this lengthy discussion applies to the foundry.

Discusses Cupola Metal

Most cast irons are melted in the cupola, whether they are to be cast directly or subjected to a duplexing operation. Even Bessemer steel passes first through the cupola. There is some interest, and should be more, in the control of the carbon content of cupola metal. Let us see why this carbon content is not constant or solely dependent on the carbon of the charge.

Carbon content of cupola metal—By the principles discussed for the blast furnace, steel scrap will gain carbon and reach the melting zone at a higher carbon content than it had when it entered the cupola. How high this carbon content will be will depend largely on the ratio of surface area to volume of the scrap used. Pig iron will find itself in an environment in the upper zone of the cupola suitable for decarburization, but being of low ratio of surface to volume, it will not experience much decarburization. It is likely, however, to melt higher up in the cupola than steel because its melting point is lower (unless the steel has been recarburized to equilibrium).

Subsequently the mixed liquids are enriched by contact with coke, especially when accumulated in the hearth or well of the cupola. Since the time of contact is less than in the blast furnace, and the temperature lower, the recarburization seldom, if ever, reaches the eutectic concentration.

All this indicates that a cupola operating largely on pig iron will produce a product little lower in carbon than the charge, whereas one operating with light steel scrap may produce liquid metal higher in carbon than the charge. The conditions vary further with time of exposure and temperature.

Hot metal held long in the cupola hearth will strive toward higher carbons, as will steel held long below the melting point in an atmosphere rich in carbon monoxide.

Since the rate at which coke will burn, which depends on density and size of lumps, will determine how far above the tuyeres melting will occur, this factor also enters into determining the carbon content.

For a given blast pressure, the rate at which the cupola will take air depends mainly on the resistance of the charge in the stack to air flow. Deep charges and charges that pack closely diminish the air intake and hence the melting rate at a given pressure. The tuyere area itself exercises little influence on the rate of input of air; hence in a given cupola the velocity of air at the tuyere is inversely proportional to tuyere area. If the blast is to penetrate well into the charge, the tuyeres must be reasonably small lest the air currents merely percolate up near the cupola walls.

Description of Principles

Shall we now visualize what happens in the cupola with respect to heat evolution and chemistry?

Much has been written in this field without greatly clarifying the subject. A major stumbling block is that none of the reactions proceed to equilibrium. It is a waste of time, therefore, to attempt any exact quantitative calculations, and we had best confine ourselves to a qualitative description of principles.

In intent at least, a cupola while operating does not change in temperature at any given level. Therefore, the heat evolved by burning in any thin layer is exactly balanced by the heat carried downward in the form of increased temperature by metal and unburned fuel that carried upward by the increased heat content of the gaseous products of combustion, and that lost through the walls. For the sake of illustration, we may confine our thoughts to a unit area near the center of a large cupola and so eliminate the wall loss from our discussion.

The several gains and losses of heat, even with this simplification, are not predictable. The amount of coke burned in unit time and the heat evolved per unit of weight depend on the gas composition, on the area of coke-gas interface, and on the temperature. The amount of unburned coke passing downward depends on the rate at which coke in and below the layer being consid-

(*Continued on page* 138)

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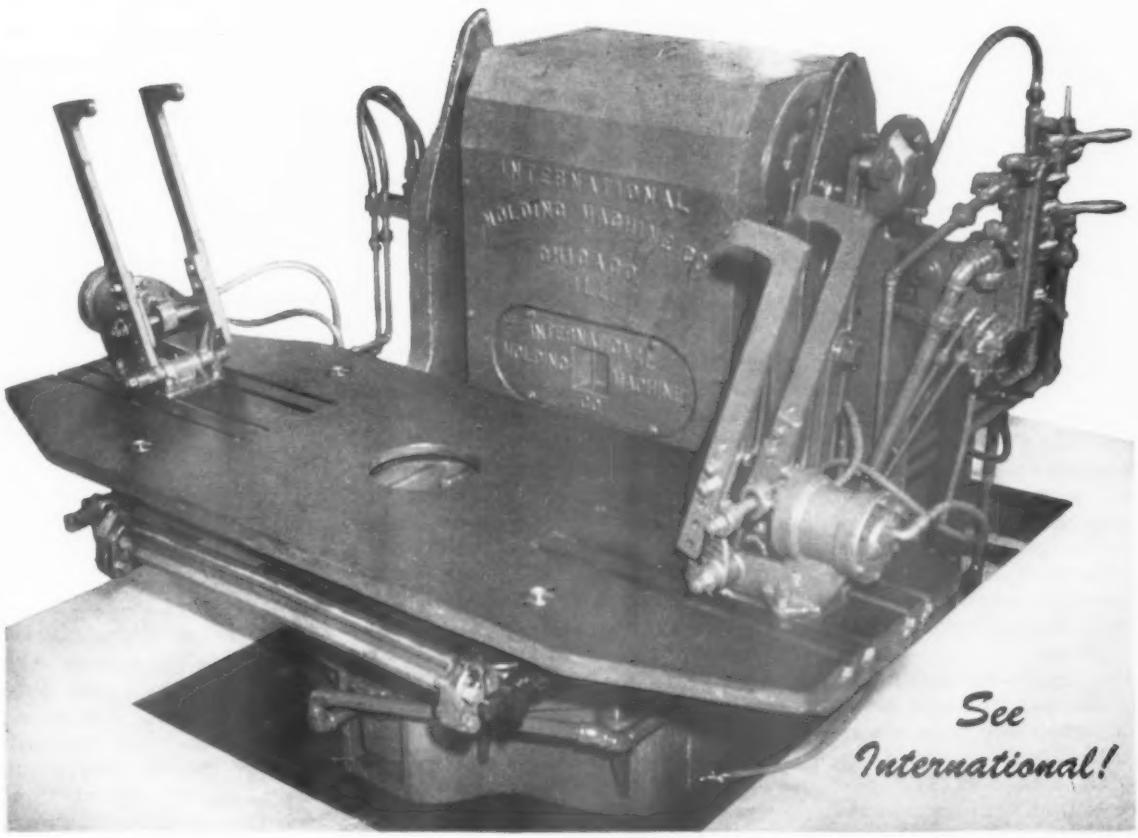

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(*Continued from page* 136)
ered burns.

The amount of heat passing into the iron depends on the surface exposed and on the temperature. The increase in the heat content of the gas in passing through the layer is that liberated by fuel burning, less that absorbed by descending fuel and metal, and therefore is related to the iron-coke ratio of the charge. The temperature of the layer is the integration of all these variables from the tuyere level to the level being studied, all the heat changes being multiplied by the appropriate specific heats.

One might set up differential equations expressing all those conditions and at best he would be confronted still by the uncertainties attending the approach to equilibrium made by the gas composition.

Air is blown into the bottom of the cupola against glowing coke. Since it takes time for oxygen to combine with solid carbon, there will be an appreciable distance above the tuyeres where free oxygen exists, and in this region the products of combustion will approximate those derived from the reaction

$$2CO_2 = 2CO + O_2.$$

As the temperature rises the reaction goes more and more completely to the right. Thus without any reaction between CO_2 and C, the ratio of CO to CO_2 increases, and the heat evolved per unit of oxygen used up grows less and less. Also as time goes on, that is, as the gas rises in the cupola, the free oxygen decreases, requiring more and more CO in relation to CO_2 for equilibrium, at a given temperature.

When the oxygen is exhausted, or nearly so, the gas will tend toward equilibrium with carbon in the reaction

$$CO_2 + C = 2CO.$$

This reaction at temperatures near the melting point of iron will go practically to the complete formation of CO at equilibrium. It is unlikely, however, that the time of contact with carbon will be sufficient to attain this end, and statements are made that instead of 100 per cent CO only 15 per cent or 20 per cent CO may be formed in the melting zone.

Of course, the combustion of C by CO_2 as has been described absorbs heat instead of liberating it. We have seen in our discussion of combustion how the maximum temperature is reached before all CO is burned to CO_2. Furthermore, the maximum temperature is decreased by the transfer of heat to the melting iron, which depends on the iron-coke ratio and the amount of heat the iron has picked up in descending to the observational zone.

As the gases ascend into progressively cooler levels, the composition in equilibrium shifts toward the formation of CO_2 and soot, and this is facilitated by the catalytic action of the iron surface. The reaction is probably faster than when it proceeds in the opposite direction, for it is less related to a time during which carbon and gas must remain in contact. The soot, if deposited, descends again toward the melting zone and if it encounters CO_2 or free oxygen, is reburned.

It is important to note that, except as affected by changes in time of contact of gas and fuel, the rate of input of air into a cupola determines the rate at which heat is generated. Coke must be fed in at exactly the rate at which it is burned. If it is put in too slowly, that is, if it burns away faster than it is put in, the level of the coke bed will drop continuously. It is impossible to put it in too fast, for there will be no room for it. To this extent the cupola is self regulating.

Decide Melting Rate

The rate at which iron is melted depends on the iron-coke ratio of the charge. Since the cupola virtually determines its own flue-gas composition, a pound of coke will liberate a given number of heat units. This will be just sufficient to melt and to superheat to a given extent a particular number of pounds of iron. If less iron than this is charged per pound of coke, a given charge of iron will be delayed in reaching the melting zone until the excess amount of coke has burned away. Actually, the melting zone will rise somewhat under these conditions, owing to the preheating action of this excess coke on the charge above, and liquid iron will have more time to superheat in flowing to the well. If more iron is charged than the coke can melt, solid iron finally will reach the cupola well.

Although the cupola is a very simple-looking object, the reader has no doubt realized that its chemistry and thermal engineering are quite complicated. This, no doubt, accounts for the violent differences of opinion existing in the field of cupola operation.

In so complex a subject, our conclusions may be clarified by certain practical observations. It actually has been found by tests on a large-scale operation that the carbon content of the charge affects that of the product, but the latter is more uniform than the former. Fast driving of a cupola, accompanied by a somewhat lower coke to iron ratio reduces the carbon content of the cupola product. Coke that breaks up fine usually produces a lower carbon, perhaps because the increased surface produces a thinner melting zone. Coke having a high kindling temperature produces high-carbon metal, perhaps by prolonging the time of contact of liquid iron with coke.

Since the steelmaking reactions were discussed in Chapter 17 as examples of decarburization, we may dismiss the melting processes involving deliberate decarburization with only a few words.

Cast irons, and more frequently malleable iron, may be melted in reverberatory furnaces charged either with solid melting stock or, especially in the latter case, with molten cupola metal.

Chemistry of the reverberatory furnace—Reverberatory furnaces were originally hand fired. Coal was burned, with forced draft, using a thick enough bed and so little air that the products of combustion resembled producer gas in being rich in CO. Additional air was supplied by a top blast admitted to the furnace just beyond where the products of combustion entered the hearth. The amount of this top blast was so regulated that the gases escaping from the furnace would contain around 1 per cent O_2, perhaps 3 per cent or 4 per cent CO, and the remainder of the oxygen as CO_2. Such a composition can be reconciled approximately to dissociation of CO_2, which should yield twice as much CO as O_2. At present, coal usually is burned in the pulverized state, but the gas composition is still similar. Incidentally, tests have shown that the ratio of hydrogen to water vapor arising from the hydrogen and moisture in the coal adjusts itself well to the CO-CO_2 ratio found in the gas. Indeed, it probably is more accurate to calculate the $H_2 - H_2O$ ratio from the equilibrium constant of the reaction

$$CO_2 + H_2 = CO + H_2O$$

than to attempt an analysis under operating conditions, in view of the small amount of H_2 encountered.

Gases of this composition are obviously in equilibrium with iron oxides of higher order. Especially below about 700° C, when FeO is unstable, Fe_3O_4 being the lowest oxide found, the solid charge suffers considerable surface oxidation. The oxides melt and if they touch a silicious lining, they are converted into complexes of FeO, Fe_2O_3, and SiO_2. Carbon is removed at a rate limited by its migration in the solid iron, and since Si and Mn do not diffuse readily,

they are not much oxidized in the solid.

When the charge is melted, and especially before the slag is removed, all three of these elements are oxidized by reaction with FeO transferred to the iron from the slag and by Fe_2O_3, which is insoluble, or unstable, in iron and reacts only at the slag surface. After the removal of slag, oxidation proceeds at a rate determined by the speed with which oxidizable elements reach the surface by diffusion or convection. These rates cannot well be measured but they are not fast, and except in thin baths, changes in composition are slow. In open-hearth furnaces the rate of carbon elimination is consistent with the idea that it is controlled by a migratory phenomenon.

Decarburization in the converter—Decarburization in the bessemer converter is peculiar in that the metal itself comes into intimate contact with atmospheric oxygen. It is thus saturated with FeO, which oxidizes silicon and manganese, and also the oxygen itself reacts directly.

The reaction constants for

$$FeO + C = Fe + CO,$$
$$2FeO + Si = 2Fe + SiO_2,$$

and

$$FeO + Mn = Fe + MnO$$

are such that at the initial converter temperature Si and Mn must be reduced to trivial concentrations before an FeO content is attained that will permit the oxidation of carbon, even from the molten cast iron with which the converter is charged.

Reduction of SiO_2 by C—At very high temperatures these reaction constants so change that the reaction

$$2C + SiO_2 = Si + CO,$$

which goes to the left near the melting point of commercial irons, changes direction and proceeds to the right at electric furnace temperatures, permitting the reduction of Si from silicious slags into steel by carbon in electric furnace practice and also the manufacture of ferrosilicon.

The reaction

2C (in liquid iron) + SiO_2 (excess solid) = 2CO (gas + Si (liquid iron)

is of some interest as typical of the preferential oxidation of one element or another in liquid iron.

The reactions

$$2C + O_2 = 2CO$$

and

$$Si + O_2 = SiO_2$$

have been studied.

Calling these reaction constants K_1 and K_2 respectively, it has been found that

$$\log K_1 = \frac{10660}{T} + 6.316; \quad (1)$$

$$\log K_2 = \frac{31200}{T} - 4.57; \quad (2)$$

$$K_1 = \frac{P^2_{co}}{(C)^2 P_{o2}} \text{ and}$$

$$P_{o2} = \frac{P^2_{co}}{(C)^2 K_1}; \quad (3)$$

$$K_2 = \frac{1}{(Si) P_{o2}} \text{ and}$$

$$P_{o2} = \frac{1}{(Si) K^2} \quad (4)$$

Equating the two values of P_{o2}, and rearranging, we have

$$\frac{P^2_{co}(Si)}{(C)^2} = \frac{K_1}{K_2} = K_3 \quad (5)$$

From equations (1) and (2)

$$\log K_3 = \log K_1 - \log K_2$$
$$= -\frac{20540}{T} + 10.886 \quad (6)$$

As the absolute temperature T rises, the fraction decreases and log K_3 and hence K_3 increases; hence with rising temperature $P^2_{co}(Si)/(C)^2$ increases.

For a constant partial pressure of CO, therefore, the silicon concentration in equilibrium with a given carbon (both dissolved in iron) rises. At room pressure, $P_{co} = 1$, and that term drops out. If a large excess of C is present and the temperature is high enough to melt iron, the activity of carbon dissolved in iron is equal to the activity of carbon itself, and C can be treated as an excess phase and its concentration disregarded, an increase in silicon with temperature being indicated under these conditions.

There is a slight inconsistency in the foregoing discussion, for equation (2) should have been written for liquid SiO_2, not solid, at the temperature at which a furnace lining of SiO_2 begins to melt.

If no excess of carbon is present, the reaction with oxygen in liquid alloys of iron, carbon, and silicon will proceed in the direction that will cause approach toward the establishment of the equilibrium conditions represented by K_3.

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Book Review

Transactions of the American Society for Metals, Vol. XLII, 1950, Ray T. Bayless, editor, 1391 pages, 6 x 9 in., published by the American Society for Metals, Cleveland.

This volume contains the papers and reports presented at the 31st annual convention of the ASM in Cleveland, Oct. 15-21, 1949.

Feature Reports at ASTM Meeting

(*Concluded from page* 115)

sented by John W. Juppenlatz, Lebanon Steel Foundry, Lebanon, Pa. The speaker pointed out that only a few years ago castings as well as other products were designed with factors of safety of about 6 to 8. Today new designs are made with safety factors of 3 to 4 and some at 1 to 1.2. Design of the casting has a vital bearing upon its quality. Its soundness requirements are predicated by service conditions which should govern the kind of nondestructive testing and its extent. The designing engineer is not a foundryman nor the foundryman a designer, but their individual progress is codependent.

Mr. Juppenlatz stated that castings are the most useful engineering construction units offering a multiplicity of shapes and components that could not be produced economically by any other means. Not all designs are economically castable. Not all designs are proper for the production of sound castings. Today these conditions are not too well understood by foundrymen and engineers alike, producing with false condemnation of castings, statements that nondestructive tests are too critical, with the real fault lying in basic design. Another fault lies in the existing competitive spirit of some foundries who are ready to accept the challenge of making castings from nearly any design to high quality standards when other foundries have failed to produce or have refused to bid when requests for practical design changes have been ignored.

In conclusion, the speaker stated that some of the new inspection tools for castings have become mature taking their respective operational positions with far reaching effects upon the industry. Unfounded fears have gradually disappeared, being replaced with understanding and proper approach. Nondestructive inspection will continue to be a force promoting the growth and economic state of the casting industry. This will require effective co-operation of management, designing engineers, foundrymen and others since casting qualities must be built into the product by judicious planning, design and controlled foundry processes. Inspection does not produce and functions only as a proving ground for the product.

L. J. Markwardt, assistant director, U. S. Forest Products Laboratory, Madison, Wis., was elected president and Truman S. Fuller, engineer in charge of works laboratory, General Electric Co., Schenectady, N. Y., was named vice president.

MAN·TO·MAN on the Molder's Bench

"Invisible Assets"

By RALPH L. LEE

ONCE in a while everything seems to break just right for me up in the Lee Hobby Foundry. When this does happen I begin to wonder whether I haven't been laying it on a bit thick when I refer to myself as an amateur foundryman. But after my experience last week the matter is settled, for there no longer remains the slightest doubt as to me being not only a full fledged and unadulterated amateur but considerably over on the rank side.

I had made a set of patterns just about as big as any I had ever tackled before. When I got ready to mold them I looked over the flask and board situation and figured that maybe, with the help of a shoe horn, I might get by. Since most of the castings I make are of bench size I knew that I'd have to bolster up the sand heap considerably. Then, when it came to melting, I really did face a problem.

After weighing the biggest of the patterns for estimating the amount of metal I'd need, it dawned on me that there were several kinds of wood in it and that the rule I was using wouldn't hold. You know when a fellow hasn't been doing much figuring lately it's surprising how rusty he can get; at least I found I had when I began to calculate the cubical content of that pattern. The darned fool mistakes I caught myself making removed the last shred of doubt as to my amateur standing.

After double checking my figures and by planning to use a king size crucible with an up-side-down ladle to cover it and the furnace, I felt that with Jupiter in a favorable position, the light of the moon over my left shoulder, rabbit's foot in the old left hip pocket and fingers crossed, I ought to get by, God willing and weather permitting.

Now the flask I had picked out, when rammed full of sand was a darned sight heavier than I could lift, and Mother (that's my home superintendent, my vice-president in charge) has absolutely drawn the line when it comes to heavy lifting. My son Ralph's gone too. But I had a card up my sleeve. I had bought a chain hoist for just such an emergency.

Well, to make a long story short, I got everything ready and checked back on myself the best I knew how. With a fairly clear conscience I whistled lightly as I went to work. I rammed the drag upside down with the pattern shored up on the board with odds and ends. Now I've walked through dozens of foundries and right by men hooking up chains and cables on flasks they were going to have lifted without so much as a thought. From now on I'm going to tip my hat—maybe genuflect—for I found that there's one whale of a lot more to this rigging up ropes and stuff than meets the casual eye.

I did manage, though, to get the drag rolled over without mishap. I hummed a little hymn. Encouraged I went ahead with the cope. Finally I was ready to lift it. I even got two spirit levels, and I fiddled around with the ropes until I felt that the slack was out of all of them, and they would lift evenly. Boy! I certainly did wish I'd had a helper. No man, I don't care who he is, could have pulled on a chain with more fearful and loving care. For just an instant I thought I had her and the next instant I *knew* I hadn't. One whole corner of the cope had dropped.

I wondered whether that darned old hoist wasn't too rough for each link seemed to bump over the pulley. Then it struck me that maybe the rope I was using was too springy. When I went over the flask with an eagle eye, I thought surely I had put my finger on the spot, for I had made it when lumber was hard to get and I must say that the pins and the guides weren't what you'd call works of art.

But just for luck I cleaned off the drag and patched her up and took one more try the way things stood, with even a worse drop. I put some bars in the flask—another drop. Then I took the bull by the horns, threw the old flask out on the scrap pile and made me a new one and if I do say it myself, it's a humdinger. But doggone the luck if I didn't have another drop even with the new flask. I brushed aside the thought that maybe it was the parting.

By this time the old dander was up and I said to myself, "I'm a son of a gun, if I'm going to let this blankety blank job get me down."

Even though I had done what I thought was a good job on the pattern, just to be sure, I decided to look her over for those pesky backdrafts which have the habit of sneaking into a pattern the minute your back is turned, and sure enough I found some. At this point I made up my mind that never again would I try to put a pattern into the sand without going over every square inch of it, even if *I* had made it.

I fixed the p a t t e r n and went through the whole rigamarole of molding again. *Another Drop!* For a moment I had a very sinful thought —"I want this darned casting," I said to myself. "I've got to start out on another trip and who'd be the wiser, if I slipped it into the foundry up in Pontiac?" Well I didn't; virtue won by a very, very narrow

(*Concluded on page* 142)

"The foundry is in full operation this morning . . . thanks to you"

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ADDRESS ALL COMMUNICATIONS TO THE OFFICES

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Repair Parts Manager
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Chicago 6, Illinois

Dear Mr. Moran:

The shipment arrived in Cleveland at 10:00 o'clock A.M., Saturday morning. We had our truck at the dock waiting and within forty-five minutes, the shipment was in our plant and being installed. The foundry is in full operation this morning — thanks to you.

I want to take this opportunity, on behalf of the entire organization, to express our thanks to you for the excellent service you rendered us on this job. Instead of saying "excellent service" - I should say "super-excellent service", for without your help, not only in getting the parts ready for shipment, but also for your efforts with the Norwalk Transportation Company, we would have been in very bad shape. What you, and your organization, did for us in our dilemma will not be forgotten soon and if at any time in the future we can reciprocate, we will be standing by to render any service possible.

Again thanking you - and would ask that you pass our thanks to all parties concerned - we beg to remain,

Yours very truly

L. J. Follen
PURCHASING AGENT

Thanks, Mr. Follen . . . your letter helps to point out that National Engineering Company stands ready to furnish spare parts and service at a moment's notice. We realize the importance of uninterrupted operation, and will always do our best to help keep your foundry in full operation . . . by furnishing a Simpson Mixer part, or providing completely engineered plans for new or revised layouts.

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(*Concluded from page* 140)

margin. How could I ever hold up my head again? So back I went to the job although I must admit there was not a song on my lips, the only sound that came out of my mouth was that of the gritting of teeth.

This time, after scanning the old horizon, my eagle eye landed on the sand heap. It suddenly dawned on me that I had been using most of the sand in it for nigh onto four years, and that maybe it, like me, was just about worn out. Then I wished I had some way of testing the green sand strength.

I took an old core box, one for a straight core, and rammed it up with some of the sand, took one side off, and using the other as sort of a dryer, I kept sliding the stick of sand out until it could no longer bear its own weight and broke off. I measured the length of that piece and compared it with three other similar pieces and found that they didn't vary enough to shake a stick at. Then I used this Rube Goldberg method to compare the sand in my heap with other respectable sands I had around the place and found that my hunch was right.

I finally got my casting after six failures each of which took one whale of a lot of shoveling and even more patience. By the way, the last drop of metal from the crucible just barely brought the metal up in the sprue and risers.

I certainly am not writing this story to make a hero out of myself or to show how perseverance wins in the end, but how dumb a fellow turns out to be when he tries to do everything all by himself. There's not the slightest doubt in my mind that if I had been doing this very same job in any number of foundries I can think of, there'd have been somebody ambling by at just the right time to save me a lot of the muddling around I went through for each of the hurdles I had to get over.

It has often struck me as being nothing short of a miracle how a foundry gang, used to working together for years manages to keep the wheels turning over during changes in management. And it's also nothing short of a miracle how a foundry, giving its last gasps or already pronounced dead, can be brought back to life and set up on its feet by a drastic change to the right kind of management.

But just the same I can't help but think of case after case where foundry organizations and other kinds of organizations, too, have carried on, maintaining their identity with the trade in spite of one, two, and even three radical shifts in top leadership.

Maybe I've been working alone in my foundry so much that I'm beginning to talk out loud to myself, which of course could be a very bad sign. But regardless of the state of my balance, I'm just about convinced that the peculiar knacks each member of a team gets onto through the daily grind of his specialized job are really the blood of an organization, keeping it alive and breathing through famine, fire and flood.

It might be a darned good idea for each of us to take an inventory, now and then, of the knacks other people have that we do not have and can't very well get along without. They might well turn out to be our greatest business assets, even though they can't be shown on the inventory, listed under the heading of good will, or indicated on the organization chart. I believe I'm a better man as a result of my suffering last week.

Meetings of Interest to Foundrymen

Sept. 13-16—National Association of Foremen, annual convention, Statler Hotel, Buffalo

Sept. 25-26—Steel Founders' Society of America, fall meeting, The Homestead, Hot Springs, Va.

Sept. 28-30—All Canadian Foundry Conference, sponsored by Eastern Canada and Ontario Chapters of AFS, Royal Connaught, Hamilton, Ont.

Oct. 5-6—Texas Regional Foundry Conference, sponsored by Texas Chapter and Texas A. & M. Student Chapters of AFS, Plaza Hotel, San Antonio, Tex.

Oct. 12-14—Foundry Equipment Manufacturers Association, annual meeting, Greenbrier Hotel, White Sulphur Springs, W. Va.

Oct. 12-13—Gray Iron Founders' Society, annual meeting, Netherlands Plaza Hotel, Cincinnati

Oct. 13-14—Northwest Regional Foundry Conference, sponsored by Washington, British Columbia, Oregon Chapters and Oregon State College Student Chapter of AFS, Gowman Hotel, Seattle

Oct. 13-15—Non-Ferrous Founders' Society, annual meeting, Hotel Statler, Boston

Oct. 16-20—National Safety Congress and Exposition, Congress, La Salle, Morrison, and Stevens Hotels, Chicago

Oct. 23-27—National Metal Congress and Exposition sponsored by American Society for Metals, American Welding Society, Metals Branch—American Institute of Mining and Metallurgical Engineers, and Society for Non-Destructive Testing, International Amphitheatre, Chicago

Oct. 27-28—New England Regional Foundry Conference, New England Foundrymen's Society, Massachusetts Institute of Technology, Cambridge, Mass.

Nov. 2-3—Metals Casting Conference, sponsored by Purdue University with Central Indiana and Michiana Chapters of AFS, Purdue University, West Lafayette, Ind.

Nov. 2-3—Annual Conference on X-ray and Electron Diffraction, Mellon Institute for Industrial Research, Pittsburgh

Nov. 9-10 — National Foundry Association, annual meeting, Edgewater Beach Hotel, Chicago

Nov. 9-11—Steel Founders' Society of America, annual technical and operating conference, Carter Hotel, Cleveland

Nov. 10-11—Michigan Regional Foundry Conference, sponsored by Michigan AFS Chapters and Michigan State College, Michigan State College, East Lansing, Mich.

1951

Feb. 8-9—Wisconsin Regional Foundry Conference, sponsored by Wisconsin Chapter of AFS and University of Wisconsin, Schroeder Hotel, Milwaukee

Feb. 22-23—Birmingham Regional Foundry Conference, Birmingham District Chapter and University of Alabama Student Chapter of the AFS, Tutwiler Hotel, Birmingham

Mar. 9-10—Ohio Regional Foundry Conference, sponsored by Ohio Chapters and Ohio State University Student Chapter of AFS, Case Institute of Technology, Cleveland

Apr. 23-26—American Foundrymen's Society, annual convention, Buffalo

June 18-22—American Society for Testing Materials, annual meeting, Atlantic City, N. J.

Nov. 15-16 — National Foundry Association, annual meeting, Waldorf-Astoria Hotel, New York

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FOUNDRY "A" cleans gray iron castings. A change to Malleabrasive saved them 51.8% on blast cleaning, produced cash savings of $2300 a machine annually and increased production 25%!

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TEST MALLEABRASIVE in your plant—you'll recognize it in the handy orange striped 100-lb. bags. We'll send you all the necessary data. Remember, Malleabrasive is *guaranteed* to outperform conventional abrasives when these comparative tests are properly made. Write for your free TEST KIT today! Address: PANGBORN CORPORATION, 1400 Pangborn Blvd., Hagerstown, Md.

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BLAST CLEANS CHEAPER with the right equipment for every job

*U. S. Patent #2184926 (other patents pending)

Foundry STATISTICS

Ingot Brass and Bronze

(Shipments in net tons)

	1949	1950
Jan.	19,456	18,874
Feb.	15,026	18,487
Mar.	14,550	22,494
Apr.	10,695	22,118
May	11,114	23,643
June	9,696	.....
July	10,220	.....
Aug.	14,194	.....

Source: Ingot Brass and Bronze Industry.

Foundry Production Workers

Estimated Number

	Mar. 1950	Feb. 1950	Mar. 1949
Iron & Steel	181,500	176,600	213,500
Nonferrous	69,700	67,700	65,300
Average Weekly Earnings			
Gray Iron	$59.60	$58.50	$53.82
Malleable Iron	61.46	59.21	53.80
Steel	60.72	59.87	59.40
Nonferrous	63.51	62.33	59.48
Average Weekly Hours			
Gray Iron	40.3	39.5	37.4
Malleable Iron	39.5	38.6	35.7
Steel	39.1	38.7	39.0
Nonferrous	40.4	39.5	38.6

Labor Turnover Rate (Mar.)

(Per 100 employees)

	Total Accession	Total Separation	Quit	Layoff
Gray Iron	4.9	4.4	1.4	2.6
Malleable Iron	5.5	2.9	1.1	1.2
Steel	7.1	1.9	0.8	0.9
Nonferrous	5.5	5.8	1.5	4.0

Source: Bureau of Labor Statistics.

Index of Foundry Equipment Orders

Foundry Trades Only

(Net Orders Closed, New Equipment)

	1949	1950
Jan.	149.9	159.3
Feb.	144.4	113.1
Mar.	190.8	225.2
Apr.	172.0	160.6
May	121.9	294.9
June	164.9	.....
July	146.6	.....
Aug.	127.1	.....
Sept.	166.6	.....
Oct.	133.5	.....
Nov.	270.4	.....
Dec.	201.0	.....

Note: Figures are percentages of the base period 1937-1939 taken as 100 per cent (monthly average). Source: Foundry Equipment Manufacturers Association.

Shipments of Castings

(Reported by Bureau of the Census)

Gray Iron

(Net tons)

	Shipments Total	Shipments For Sale	Unfilled *Orders
1948			
Total	12,785,909	7,131,405	.....
1949			
Mar.	1,074,704	567,041	1,639,465
Apr.	929,307	467,433	1,445,532
May	866,631	439,420	1,243,266
June	905,573	455,442	1,086,989
July	696,915	341,657	1,031,963
Aug.	872,013	445,981	1,048,308
Sept.	880,647	459,014	980,070
Oct.	715,685	397,939	955,100
Nov.	718,703	395,107	938,629
Dec.	862,172	440,409	892,458
Total	10,549,284	5,517,527	.....
1950			
Jan.	913,321	449,577	914,185
Feb.	864,189	416,594	873,455
Mar.	995,782	500,195	921,575
Apr.	981,126	483,862	922,255

Steel

(Net tons)

	Shipments Total	Shipments For Sale	Unfilled *Orders
1948			
Total	1,760,032	1,335,295	.....
1949			
Apr.	119,953	83,277	250,506
May	106,178	75,537	191,473
June	116,052	84,112	173,237
July	78,710	50,124	155,494
Aug.	89,964	59,412	143,566
Sept.	86,502	55,853	127,664
Oct.	70,690	48,263	124,817
Nov.	76,437	50,685	117,865
Dec.	84,508	53,079	122,887
Total	1,243,502	865,297	.....
1950			
Jan.	88,821	57,996	142,484
Feb.	91,827	62,045	165,186
Mar.	111,772	77,588	185,611
Apr.	106,964	75,133	201,643
May	117,944	83,845	198,078

Malleable

(Net tons)

	Shipments Total	Shipments For Sale	Unfilled *Orders
1948			
Total	933,265	525,212	.....
1949			
Apr.	61,329	31,728	94,958
May	54,572	27,643	78,944
June	59,597	32,639	69,865
July	44,360	23,216	70,796
Aug.	58,121	30,327	61,330
Sept.	60,488	30,646	57,512
Oct.	57,150	28,582	54,322
Nov.	49,439	25,250	55,795
Dec.	57,379	29,679	60,835
Total	713,107	370,967	.....
1950			
Jan.	62,874	32,918	62,307
Feb.	60,386	31,249	67,049
Mar.	66,259	38,639	69,866
Apr.	69,822	36,279	76,250
May	76,161	42,432	77,074

Copper-base Alloys

(Thousands of pounds)

	Shipments Total	Shipments Sand	Shipments Perm. Mold	Unfilled *Orders
1948				
Total	1,030,825	930,790	59,009	.....
1949				
Mar.	70,173	62,557	3,927	37,646
Apr.	59,573	52,837	3,458	32,746
May	53,699	48,004	2,830	30,926
June	52,616	47,678	2,552	26,786
July	43,273	39,372	2,129	26,013
Aug.	58,055	53,203	2,929	26,071
Sept.	60,771	55,221	2,729	26,527
Oct.	58,249	52,861	2,316	23,634
Nov.	61,818	56,669	2,811	23,625
Dec.	63,873	58,291	3,086	23,435
Total	725,318	654,444	37,311	.....
1950				
Jan.	65,585	58,878	3,440	25,216
Feb.	67,029	60,257	3,626	26,923
Mar.	80,442	71,876	4,693	27,631
Apr.	72,478	64,773	3,848	29,080

Magnesium

(Thousands of pounds)

	Shipments Total	Shipments For Sale	Unfilled *Orders
1948			
Total	8,214	7,488	....
1949			
Mar.	879	800	3,227
Apr.	726	669	3,234
May	778	726	2,885
June	799	759	3,025
July	689	637	3,073
Aug.	753	712	3,107
Sept.	727	691	3,015
Oct.	796	763	3,050
Nov.	801	769	2,399
Dec.	781	738	2,216
Total	9,364	8,781	....
1950			
Jan.	814	762	2,237
Feb.	735	676	2,218
Mar.	903	849	2,322
Apr.	799	751	2,305

* For sale only.

Aluminum

(Thousands of pounds)

	Shipments Total	Shipments Sand	Shipments Perm. Mold	Shipments Die	Unfilled *Orders
1948					
Total	424,490	139,781	161,334	118,738	.....
1949					
Mar.	27,478	9,348	9,386	7,999	50,508
Apr.	23,801	8,041	8,353	6,876	45,638
May	21,392	7,582	7,293	5,994	41,460
June	23,261	8,668	7,790	6,257	38,159
July	18,621	6,311	6,592	5,180	36,993
Aug.	23,997	9,048	8,326	6,119	38,130
Sept.	27,546	9,923	9,491	7,623	38,179
Oct.	29,071	9,634	9,923	8,908	37,881
Nov.	26,317	9,212	8,315	8,348	36,846
Dec.	26,762	10,070	7,714	8,430	36,921
Total	304,616	106,825	102,908	88,019	.....
1950					
Jan.	28,801	9,646	9,400	9,052	40,591
Feb.	28,887	10,171	9,358	8,851	44,235
Mar.	35,845	13,035	11,094	10,870	47,350
Apr.	33,384	11,091	10,656	10,823	50,024

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• ALUMINUM FLUXES	*for cleansing and grain refining all alloys*
• MAGNESIUM ALLOYS	*for all types of castings*
• MAGNESIUM ANODES	*for cathodic protection*
• ZINC ALLOYS	*for die castings and metal forming dies*

In the Apex laboratories, Apex research and facilities are devoted to producing *better* ingot, analyzing particular problems for foundries who use *all* methods of castings—sand, permanent mold or die casting. Thus, Apex maintains always this high standard: "Best in every test from Ingot to Casting!"

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MECHANIZES PRODUCTION of Textile Machinery Castings

LARGE-SCALE production of textile machinery castings is attained by the Draper Corp as the result of mechanization of its Hopedale, Mass., gray iron foundry. Outstanding feature of the installation are two molding lines served by power mold conveyors and overhead sand distribution system.

Mechanical handling also is employed in the melting department. Raw materials are unloaded by a 7½ - ton - capacity overhead crane from railroad cars which enter the storage building on a spur track. This same crane, equipped with magnet, is used to make up cupola charges, depositing pig iron and scrap into a weigh hopper. Weight of each item is recorded on a tape. Contents of the hopper then are dropped into a cone type charging bucket which is brought into position on a transfer car. The car then is moved to other overhead hoppers to receive coke and limestone and finally transfers its load to the charging crane, where the buckets are lifted to the cupola charging floor.

The foundry has three cupolas, two melting 19 tons per hour each and one 7 tons. The two larger units are used on alternate days and are tapped continuously into a holding ladle for transfer to the pouring ladles.

A central sand system includes three mullers which process about 100 tons of synthetic molding sand an hour. This is delivered by overhead conveyor belts to hoppers above each molding station, from where it is released by the machine operator by means of a foot valve. A grating at each station permits spill sand to fall onto a belt which returns it to the storage bin and back to the mullers.

Each of the two mechanized molding lines consists of 18 molding stations equipped with Tabor 10-in. yoke type jolt-squeeze machines. Finished molds are handled by National Engineering intermittent train type conveyors. There are four trains for each of the two loops and each train has 36 cars. This provides two cars for each molder. The trains do not move continuously but travel on the average of about once every 6½ minutes. First they move from the molding stations to the pouring station, then to the cooling area and finally to the shakeout.

Each molder is able to place from five to eight molds on a train, depending on the size or type of mold, during the approximately 5 minutes the train is stationary at the molding line.

One of the accompanying illustrations (Fig. 2) shows the pouring stations of the two conveyors. At the right the train is shown in the pouring zone and the pouring operation under way. At the left, one train has been poured off and is moving out of the pouring zone, while the new train bearing unpoured molds is moving into position. The locomotive is in the foreground. Operators stand ready to start placing jackets and weights as soon as the conveyor stops, so that pouring can proceed immediately. After pouring and before the conveyor moves into the cooling zone, weights and jackets are removed. Two cooling chambers remove smoke and heat generated from the molds.

From the cooling hood the molds

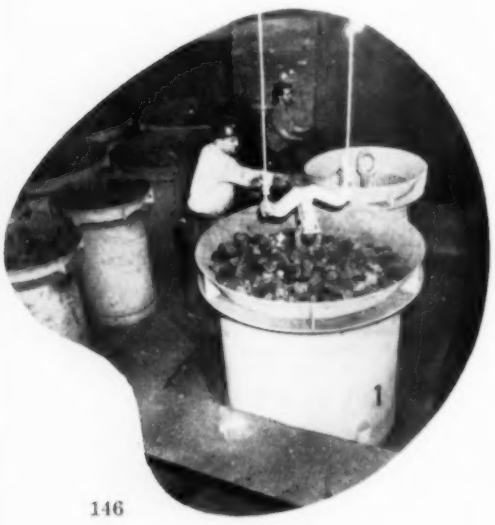


Fig. 1 — Making up cupola charges

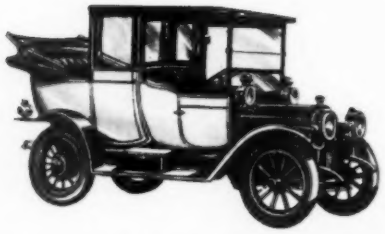
Fig. 2—Pouring stations on the two conveyor lines. Conveyor cars are drawn by locomotives of type shown at left. Fig. 3—Battery of jolt-squeeze machines feeds molds to conveyor at right. Fig. 4—Filling pouring ladle from holding ladle. Fig. 5—Pouring off on side floor

are moved to the dump-out where they drop onto an apron conveyor for travel to the shakeout. Bottom boards remain on the train and are returned to the molders. Sand falling through the shakeout grid is carried by belt conveyor over a magnetic separator and then to a bucket elevator which raises it to the storage bin of the central sand system. There the sand is screened for removal of extraneous material before it enters the bin.

Castings recovered at the shakeout drop to a conveyor which travels a circuitous route to the charging area where sprues, gates, etc., are removed for return to the cupola. The castings then go to a take-off station near the cleaning department where they are sorted according to types.

Castings made on these two lines range in size from .03 to 5 pounds. All molding is done with matchplates in snap flasks. Production varies with different types of castings but individual machine operators on some jobs have produced as high as 65 to 70 molds an hour.

1912



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1950

130 BRAKE HORSEPOWER . . . 18 MILES PER GALLON!

MORE HORSEPOWER— LOWER OPERATING COSTS!

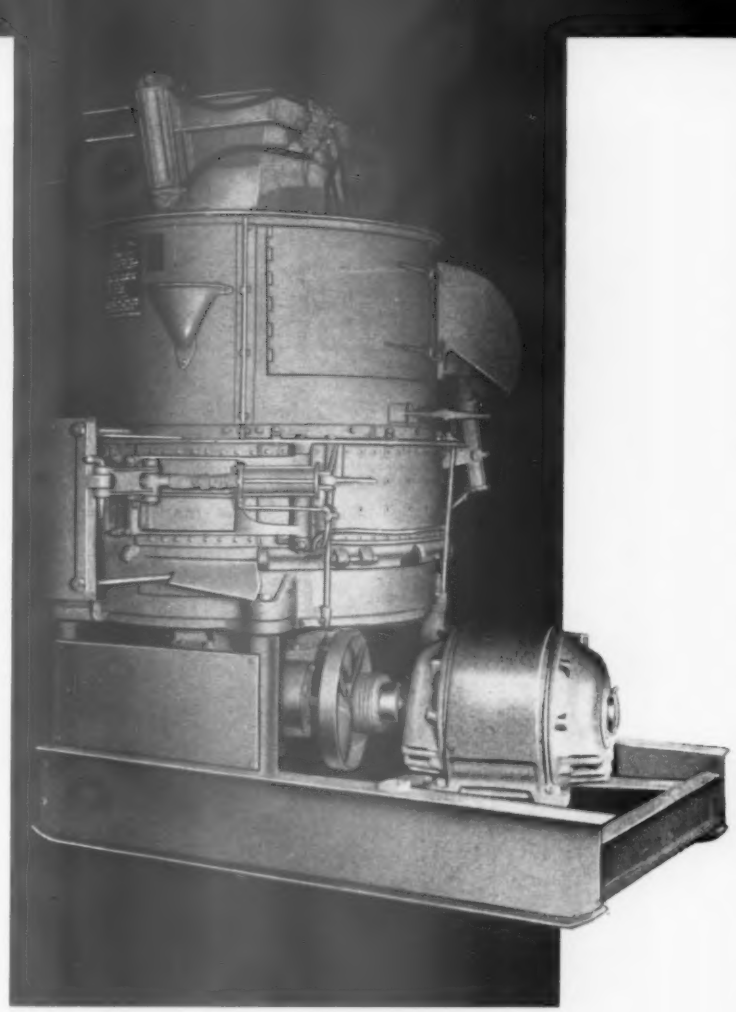
The horsepower of the automobile has been doubled and its speed greatly increased. At the same time, gasoline consumption per mile has been greatly reduced and service life lengthened. This same trend, towards increased power and speed with resultant economies, is apparent in the aircraft, the railroad locomotive, the machine tool and all other progressive industries.

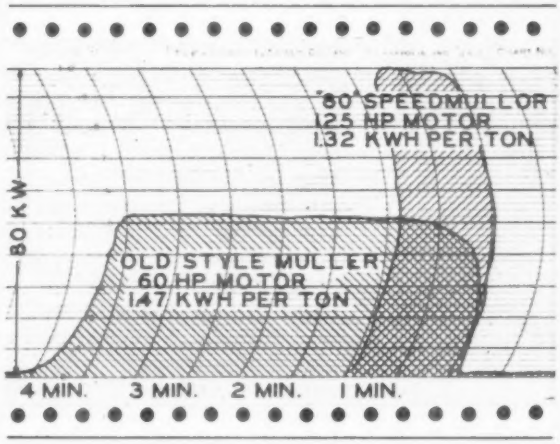
The Speedmullor is a result of the same type of progressive engineering development applied to the foundry machinery industry. The Speedmullor embodies a new principle of mulling and is capable of utilizing higher speed and power and producing foundry sands mulled to their *maximum attainable* physical properties with the lowest material cost, the lowest power cost and the lowest operating and maintenance cost per ton.

SPEEDMULLOR

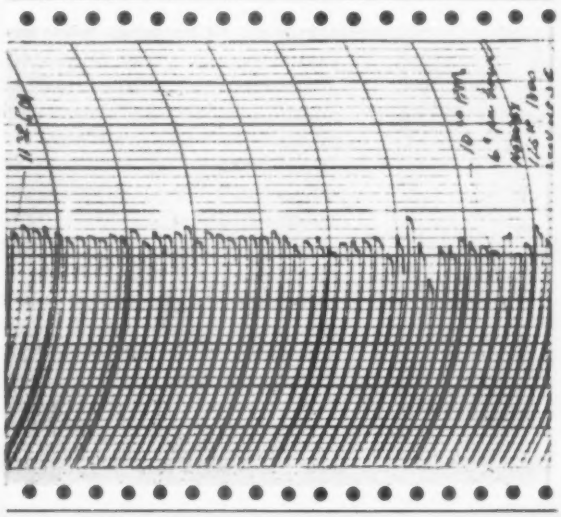
THE MODERN, HIGH POWER, LOW COST METHOD OF MULLING

Like other modern machines, the high powered Speedmullor accomplishes a far better job in less time . . . and at lower cost. With lightweight moving parts, the Speedmullor utilizes centrifugal force to mull sand faster and more thoroughly than any old style muller. The rubber tired mulling wheels of the Speedmullor transmit twice the mulling pressure and cover three times as much mulling area as the heavy, slow-rolling vertical wheels of the latest design of old style muller.





A typical watt-hour meter record of operation of a manually controlled Model "80" Speedmullor during a period of operation of exactly one hour. Fifty batches were uniformly and thoroughly mulled . . . over 1150 cu. ft. of sand mulled to ultimate physical properties in one hour. The Speedmullor's high capacity and its thoroughness of mulling assure the lowest overall cost per ton of sand completely mulled.



Typical are the results of recent tests run on a Speedmullor and an old style muller of the latest design, both preparing the *same* sand in the *same* sand system. The Speedmullor, utilizing higher horsepower for a far shorter period of time, consumed 1.32 K.W.H. per ton of sand mulled to maximum physical properties. The old style muller, utilizing lower horsepower for a far longer period of time, consumed 1.47 K.W.H. per ton of sand mulled to approximately equal properties.

A NEW 36 PAGE BULLETIN CONTAINING THE LATEST INFORMATION ON MULLING

Facts, figures, illustrations and installation photographs . . . the new 36 page Speedmullor bulletin is chock full of the latest data. It presents the story of mulling as well as the story of the Speedmullor's development and authoritative engineering information on all Speedmullor models and on the popular B&P Combination Sand Conditioning and Mulling Units. Send for your free copy today!

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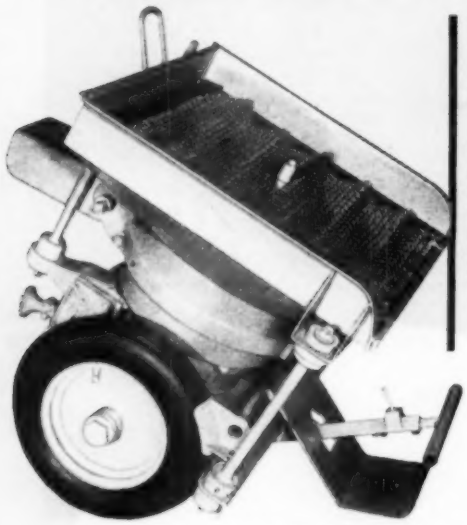
NOW...MORE THAN EVER

the Lowest Cost sand conditioner!



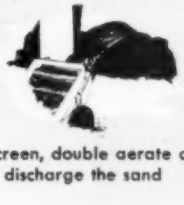
Improved features of design and construction make the Screenarator—now, more than ever—the lowest cost sand conditioner! The Screenarator is lowest in original cost and lowest in maintenance cost per ton of sand thoroughly conditioned. Its simple, tested design and rugged construction assure trouble-free performance. Thousands of Screenarators in foundries throughout the world have proved to be unbeatable sand conditioning investments.

THE SCREENARATOR

Three Screenarator models with capacities of 20 to 45 tons per hour produce *thoroughly* screened, *twice* aerated, lump free, fluffy, flowable sand. All types of sand are prepared with the same thoroughness and economy. Both jobbing and production foundries find that the Screenarator pays for itself in a short time. Write today for a Screenarator bulletin!

1. Move it to any foundry floor

2. Plug into a power outlet



3. Screen, double aerate and discharge the sand

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Crankshafts

(*Continued from page 75*)

facing, although somewhat difficult to work, being very low in green strength, assures high flowability and density, as well as maximum hardness upon baking. Figs. 5, 6, 7, 10 and 11 illustrate the progress of these operations. Facing sand mixtures are included in the accompanying Table I on page 152.

Patterns are drawn from the molds by the co-ordinated efforts of the molding crew (Fig. 12), no satisfactory mechanical means having been devised for this purpose because of the awkward length and flexibility of the patterns. Molds are twice dried in an air-circulating oven at 425° F, being held at this temperature for 8 hr on each occasion. The first cycle follows immediately upon removal of the pattern and after careful spraying with a medium coat of mold wash paste made up to a creamy consistency with water. The second drying is conducted with the cores in place, the cracks luted and the entire assembly again invested with the wash, this time brushed on by hand to make sure all joints and cracks are fully covered. Figs. 13, 14 and 15 present the sequence of these procedures. Fig. 16 is a view of copes and drags racked in the oven for the final drying.

Cores — For crankshafts molded and poured in the manner outlined here, coremaking presents special problems not encountered in ordinary founding and which as yet have not been adequately solved. Although the composition given in Table I is generally satisfactory, extreme care must be used in tempering the mixture, in venting, assembling, and drying to duplicate the established procedure with each batch. Even a small departure from the fixed routine, however trifling in itself, may result in serious trouble, sometimes reflected in an epidemic of rejected castings which is always baffling because the digression was so trivial that it slipped in all unnoticed. This, of course, is true and must apply in all the multifarious steps required to produce a good crankshaft, or any other casting, for that matter. But since repair by welding in any form is unsatisfactory with the special iron used in these units, as well as being impermissible for the service, a flawless product is imperative when it emerges from the mold.

Because of the excessive hydrostatic pressure developed when the mold is elevated to the vertical position im-

mediately after pouring, it will be realized that cores for this purpose must develop extreme hot strength to prevent collapse or metal penetration. This is the reason for employing high percentages of silica flour and the application of a good refractory wash. In our practice cores are subjected to a triple baking; twice in the core oven at 385° F and once after setting in the mold as previously described. The first drying is applied to the green cores for a period of 7 hours; the second, for a similar time, after pasting and washing.

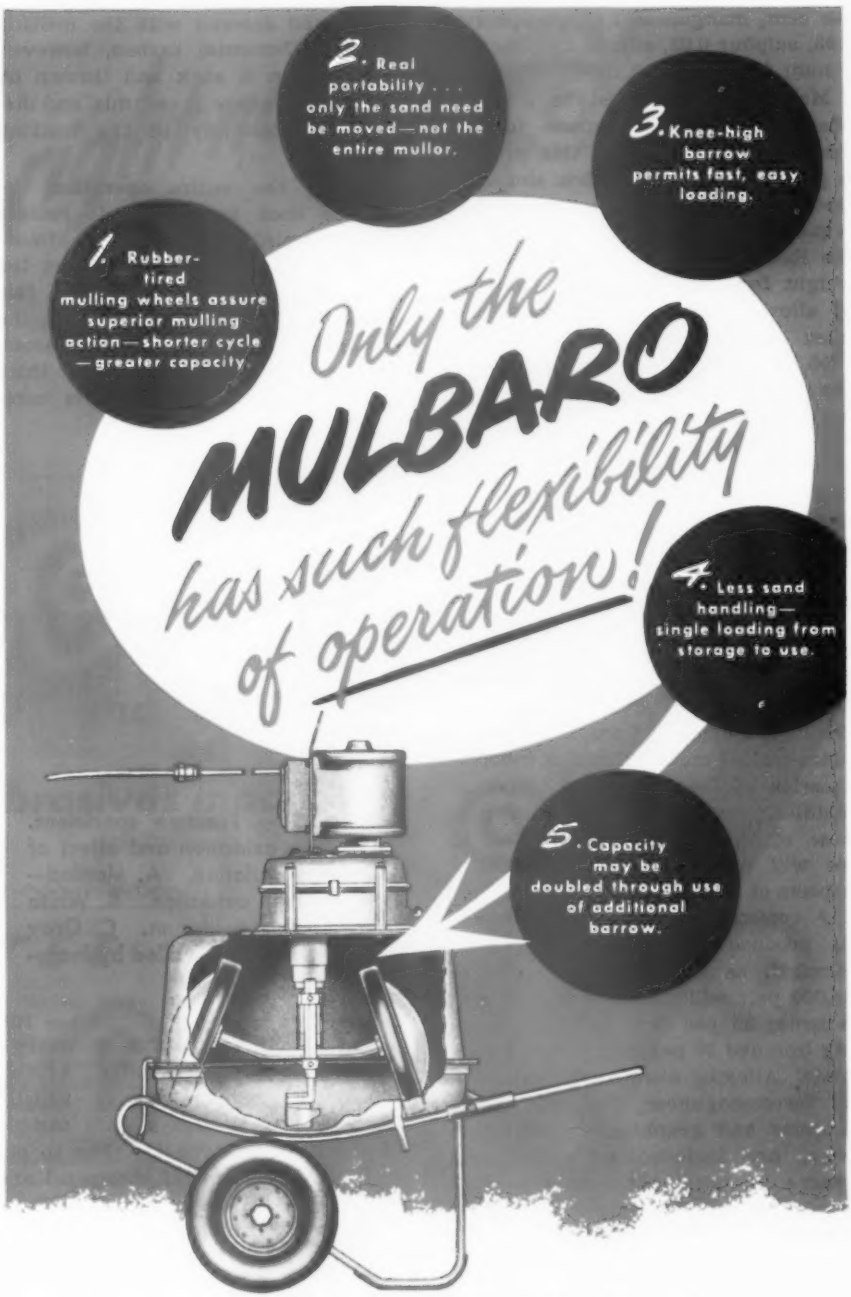
Complete drying of sand mixtures containing silica flour much over 20 per cent is very difficult, making the procedure here recounted altogether necessary. Split cores are vented, pasted and assembled in the manner shown in Figs. 17 to 21, inclusive. In certain cases wax is used to form the vent holes but since it saturates the sand with a gas forming substance not driven off at drying temperatures, it is not recommended except in places far removed from hot metal surfaces.

Melting — Before describing the melting operation, a word about chemical composition should be interposed. Any of several proven analyses will suffice to develop high tensile strength and good machinability when the metal is properly processed and suitably inoculated. A choice from among these thus will be influenced largely by its ease of control, its stability in the molten state, its shrinkage characteristics and its economies. Examples of three generic types we have used successfully are:

TABLE II—Metal Composition

	Type A %	Type B %	Type C %
Total carbon	2.20–3.00	2.20–3.00	2.25–2.75
Manganese	1.00–1.50	1.00–1.75	0.85–1.25
Phosphorus	0.05 max	0.05 max	0.05 max
Sulphur	0.05 max	0.05 max	0.05 max
Silicon	1.50–2.50	1.60–2.60	2.10–2.65
Molybdenum	0.85–1.10	0.80–1.20	0.65–1.10
Chromium	.....	.....	0.20–0.60
Nickel	1.00–1.50	1.75–2.50	0.65–1.50
Copper	1.00–1.50	.....	.....

Precise compositions, of course, are determined by the critical section thickness, the total mass, and the cooling rate of the castings to be poured. Type C, containing chromium, is somewhat difficult to control and has a strong tendency to develop objectionable carbides in lighter sections. Type A, on the other hand, is apt to form the weaker pearlitic structure with free ferrite and coarse graphite in heavy sections. Type B is most generally employed in our practice, and for the larger crankshafts (1000 lb and over), is restricted to the following average ±5 per cent: Total carbon 2.65


2. Real portability . . . only the sand need be moved—not the entire mullor.
3. Knee-high barrow permits fast, easy loading.
1. Rubber-tired mulling wheels assure superior mulling action—shorter cycle—greater capacity.
Only the MULBARO has such flexibility of operation!
4. Less sand handling—single loading from storage to use.
5. Capacity may be doubled through use of additional barrow.

If you want *thorough* mulling, *minimum* sand handling and *real* portability at *lowest* initial and operating cost . . . then the Mulbaro is the answer! The Mulbaro is used for many different applications in large or small foundries—for core, facing and molding sand or for special batches of ladle lining or cupola patching material. Several barrows may be used alternately, thus providing the capacity of two or more mullors for slightly more than the cost of one. Write today for complete information on the Mulbaro.

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FEMA

per cent, manganese 1.40, phosphorus 0.03, sulphur 0.03, silicon 1.95, molybdenum 1.00, nickel 2.10

Melting is conducted in a 4-ton basic-lined electric furnace for no other reason than that this process is preferred for both carbon and alloy steel castings and there are, in consequence, no-acid lined furnaces at the Renton plant. Charges range in weight from 2½ to 5 tons, exclusive of alloy additions, the average and most easily managed being about 7200 lb. Physical composition of the charge will vary considerably, depending upon the mechanical properties desired in the finished crank. Iron returns (from previous crankshaft heats) may range from 15 to 100 per cent; pig iron from 30 to 55 per cent and mild steel scrap from 25 to 30 per cent.

In general, the higher the percentage of returns, the higher will be the tensile strength and brinell hardness in both the as-cast and the heat treated iron, due apparently to the higher degree of oxidation in the twice-melted metal. But that involves theories of inoculation and physical metallurgy which it is not the purpose of this article to consider; so we will proceed with the practical aspects of this discussion.

A typical furnace charge, designed to produce iron of medium high strength as cast (on the order of 65,000 psi) will comprise 35 per cent returns; 35 per cent low-phosphorus pig iron and 30 per cent selected steel plate. Alloying elements in the form of ferromanganese, molybdic oxide briquets and graphite, or petroleum coke, are included with the cold charge in suitable amounts to give percentages of these elements at melt down near to the desired final quantities. Part of the nickel and silicon also is added at this time, the remainder being given to the ladle at the time of tapping in the form of Nisiloy, an alloy containing about 60 per cent nickel and 30 per cent silicon. Charging is accomplished through the top (Fig. 22), the pig iron first, followed by the returns and steel scrap in that order. Such an arrangement minimizes the loss of silicon and carbon during the primary stages of melting. Alloys are scattered on top away from the electrodes and descend with the melting charge. Elemental carbon, however, is placed in a sack and thrown on the bottom where it can mix and dissolve progressively in the melting iron.

During the entire operation the furnace door and tap hole remain open to maintain an oxidizing atmosphere at all times. For the first ten minutes of the cycle, or until a fair pool of molten metal has formed, the power input is regulated on second tap, or 130 v; it is then set at third tap (185 v) until melting is complete, which, with a 7200-lb charge, consumes about 50 minutes. At this stage the temperature is usually around 2650° F, and a chill sample of the key-hole type is taken to observe the condition of the metal and the degree of oxidation. The fracture plane usually will appear like (A) in Fig. 23 showing a mottled area in the bulged section, indicating excess silicon and carbon and incomplete oxidation. But such conditions are desirable at this point because oxidation and a rising temperature must continue until the time of tapping, and too much loss in these elements in the early stages would necessitate adjustments later on.

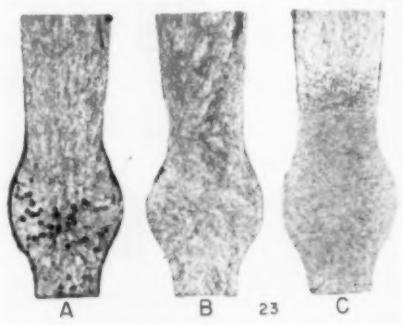

Fig. 23 — Fracture specimens, showing oxidation and effect of ladle inoculation. A. Mottled—incomplete oxidation. B. White—complete oxidation. C. Gray—chill depth controlled by inoculant

In fact, to sustain, or stimulate a positive reaction, we have found it expedient at this point to throw 30 to 40 lb of red hematite iron ore or mill scale on the bath and reset the power on second tap. About ten minutes later, when the temperature has risen to 2700° F, the resulting slag is raked off, the bath rabbled and a sample taken for preliminary chemical analysis. During the next twenty minutes, while awaiting a report from the laboratory, the power is reduced to 110 v (first tap), and the temperature permitted to ascend gradually to approximately 2775° F.

With close supervision of the preceding steps, the carbon content should now be about 2.90 per cent; the manganese 1.50 per cent and the silicon 1.70 per cent. Nickel and molybdenum are not considered since these elements remain almost constant with the calculated values. In rare cases, where the carbon is significantly low, the bath may be slagged and adjustments made by the addition of Mexican graphite or petroleum coke. Carbon absorption under these conditions is about 80 per cent and requires from 8 to 12 minutes, the end of the reaction being indicated by the cessation of small incandescent flashes over the molten surfaces. An excess of carbon can be remedied by a proportionate increase in the amount of ore employed for final oxidation which, under normal conditions, is 1 per cent by weight of the metal charged.

As previously intimated, reducing, or even neutral conditions—particularly in the final stages—are fatal to the prime objective, that of making high-strength machinable cast iron by the recourse of inoculation in the ladle. To insure success, therefore, iron ore in the quantity just mentioned is now added on the bath and allowed to react for a period of ten minutes during which the temperature will rise to 2920° F or thereabouts, although the power is still set at 110-v tap. The boiling action is not nearly so violent as is usual with steel and appears to be complete in about six minutes, but for positive results the full ten minutes is required. A maximum temperature of 3100° F is preferred, although successful heats have been tapped at 3200° F. Readings are therefore taken every three minutes during the oxidizing period and the voltage cut back, or the power entirely shut off, if the temperature rise becomes excessive.

At the end of the oxidizing cycle the slag is completely removed, new silica sand being added to promote coagulation and facilitate the task which takes from four to six minutes. A chill sample will now show a totally white fracture. (Fig. 23B.) If, dur-

(*Concluded on page* 154)

TABLE I—Molding and Core Sand Data

Materials	Facing Sand Mixtures—Machine Molded Cranks up to 1200#	Facing Sand Mixtures—Slinger Molded Cranks—1400# and upward	Core Sand Mixtures—All Cranks
Silica sand (#50) washed and dried, 68 fineness	112 parts by vol.	112 parts by vol.	16 parts by vol.
Silica flour (140 mesh)	40 parts by vol.	80 parts by vol.	80 parts by vol.
Linseed oil (raw)	4 parts by vol.	8 parts by vol.	3½ parts by vol.
Black Delta concentrated core oil			3½ parts by vol.
Water	3½–4%	3½–4%	12 parts by vol.
Dry permeability	48–50	33–35	12–14

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HANDEE, the Tool of 1001 Uses, is ideally suited for your touch-up work and smoothing of patterns. For the small jobs and in hard-to-get-at places, you cannot beat the DeLuxe HANDEE. For the heavier jobs, there is the sensational new HANDEE "85." Over 500 accessories to save you valuable time and money.

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(*Concluded from page* 152)

ing the slagging operation, the temperature has dropped below 3000°F, the current is again turned on briefly to re-establish this minimum; if not, the furnace is tapped promptly into a thoroughly dried bottom-pour ladle. The average melting time for a $3\frac{1}{2}$ to 4-ton heat is 1 hour and 50 minutes.

(*To be concluded next month*)

Malleable Founders Hold Meeting

(*Concluded from page* 111)

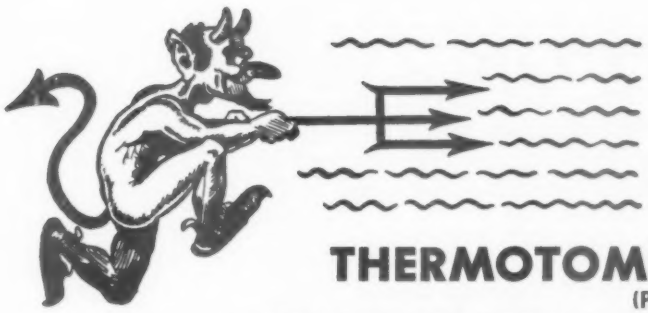
their coverage by various benefit programs. He stressed the importance of merchandising these benefit programs if the company is to obtain the most good from them in the way of improved employee morale.

In announcing the society's program for the new year at the second meeting session, Ralph T. Rycroft, the newly elected president, said that emphasis would be placed on improvement in quality and production techniques, better cost accounting methods and sales promotion. He said that the cost committee would employ a permanent consultant to aid members in using the new cost manual.

The treasurer's report, indicating the sound financial condition of the society, was given by Dudley V. Walker, Eberhard Mfg. Co. Division, Eastern Malleable Iron Co., Cleveland.

Statistical quality control methods, broadly developed in the last few years, seem to offer the best method for controlling the many variables entering into the production of castings, it was declared by Max Astrachan, USAF Institute of Technology, Dayton, O. The speaker explained the fundamentals of statistical quality control methods.

The meeting was closed with an inspirational address by Dr. Alfred P. Haake, mayor of Park Ridge, Ill., and a consultant to General Motors Corp. Speaking on "The Creeping Paralysis of Taxation," Dr. Haake stated that taxes no longer provide the means by which government is kept solvent. He ridiculed the notion held in Washington that a large debt is an indication of strength and prosperity. Managing the public debt is a major factor in establishing what kind of economy the country will have, he pointed out. The paralysis of conscience affecting the public, in looking more and more to the government for free benefits, can be corrected only through action by the individual communities, not in Washington or in the state capitals.



Soffel's

THERMOTOMIC COMPOUNDS
(Patented)
and EXOTHERMIC CARBON FREE LIQUIDIZERS

Keeps metal molten!

. . . for Steel, Iron, Aluminum, Brass, Bronze, Copper

300 lb. aluminum bronze bearing cap cast with THERMOTOMIC feeding ring core under riser. Note small feeder opening which facilitates removal of riser from casting, resulting in greatly reduced cleaning costs.

THERMOTOMIC is a patented Exothermic compound that can be molded into any desired shapes and used as feeding inserts under risers or as facing application where it is desired to maintain fluidity of the casting metal. THERMOTOMIC permits reversal of the trend towards large feeding heads and risers, making it possible to use heads that are shorter and more compact with very small feeder openings. This permits easy removal of heads and gates and sharp reductions in cleaning and finishing costs. When THERMOTOMIC is used as inserts or as facing in the mold, heat at thin metal sections is retained until the main body of the casting has solidified, thus eliminating shrink cracks and improving grain structure and tensile strength.

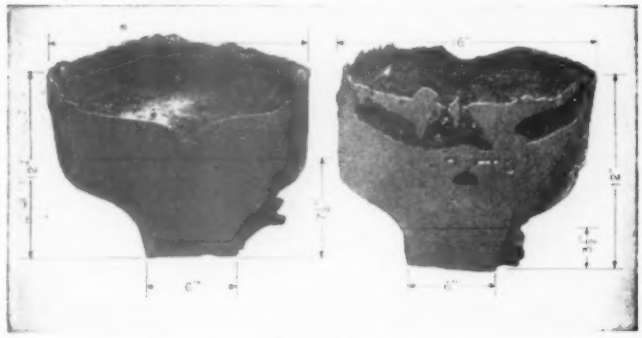
Thermotomic ABC
for
Aluminum and Magnesium Castings

THERMOTOMIC ABC is the first successful exothermic feeding compound ever to be developed for aluminum and magnesium castings. Results obtained from its use are amazing. Feeding metal in heads or risers is maintained in the fluid state for 20 to 30 minutes. Great savings are effected through reduced riser dimensions. Feeding heads or risers are reduced in volume 80% and more, and their removal from the casting is greatly facilitated due to the restricted feeding necks.

An Exothermic Feeding Head Compound and Pipe Eliminator For Aluminum and Magnesium Castings

SOFFEL'S AL-X31 LIQUIDIZER was developed for use in conjunction with THERMOTOMIC ABC. In order to secure best results and maximum feeding, we strongly recommend that AL-X31 LIQUIDIZER be applied on the feeding heads or risers. When so applied, AL-X31 LIQUIDIZER enters into an intense exothermic action which will actually raise the temperature of the feeding metal. The heat produced is sufficiently great that, even if the metal has solidified, it will re-melt. After AL-X31 LIQUIDIZER has completed its exothermic action, it forms a soft, insulating cover on the feeding metal. This cover confines the heat generated and further delays solidification of the feeding heads or risers.

SOFFEL'S CARBON FREE LIQUIDIZER PRODUCES GREATER YIELD



Steel Riser on left contains twice as much sound metal

These risers, made in the same mold, illustrate how Soffel's Carbon Free Liquidizer produces sounder castings and saves metal. The riser on the left, on which Carbon Free Liquidizer was used, contains more than twice as much sound metal as the riser on the right on which a common carbonaceous pipe eliminator was used. It is readily seen from this that the use of Soffel's Carbon Free Liquidizer permits substantial reductions in size of risers.

BEWARE OF IMITATIONS: We are the originators of Exothermic Carbon-Free Liquidizer.

PITTSBURGH METALS PURIFYING COMPANY

Manufacturers of Quality Purifying "Fluxes for all Metals and Alloys"

1352 Marvista Street **Pittsburgh 12, Pa.**

Activities of Foundry GROUPS

Twin City

AN interesting and instructive tour through the new Mechanical-Aeronautical Engineering Building of the University of Minnesota featured the May 23 meeting of Twin City Chapter of the AFS which closed the current season's activities.

Prof. Fulton Holtby first described the type of engineering graduates being prepared in the university's Institute of Technology and pointed out the need of the middleman who serves as a link between production workers and the engineering staff. This type of personnel, with a well rounded background in the technological fields, is in great demand in industry. The tour of the building was guided by members of the AFS University of Minnesota Student Chapter under the direction of John Uppgren, instructor in foundry practice. Laboratories of internal combustion engines, woodworking, plastics, welding, forging, heat treating, sheet metal working, machine shop practice, and foundry practice were described by the instructors of the respective laboratories.

Particular interest was shown in the new foundry. Some of its equipment recently was donated by local foundrymen.—*J. D. Johnson, Archer-Daniels-Midland Co.*

Pittsburgh

TECHNICAL committees of the Pittsburgh Foundrymen's Association conducted the annual roundtable May 15 at Fort Pitt Hotel. John N. Ludwig, Electro Metallurgical Co. and H. B. Reed, Westinghouse Air Brake Co., elaborated on questions pertaining to gray iron foundry practice; R. C. Heaslett, Continental Foundry & Machine Co., and John A. Meyer, National Alloy Division, Blaw-Knox Co., on steel foundry operations; and Roger D. Williams, James H. Matthews & Co., and O. Edwin Decker of Acheson Mfg. Co., on nonferrous operating problems.

Major topics discussed included trends in production of nodular iron, use of oxygen in steel foundry operations, utilization of the Croning process in making nonferrous castings, prospect of widening application of the basic-lined cupola, and possibility of using tin substitutes in nonferrous foundries in event of another war.

Election of association's officers for the coming 1950-51 term resulted in the following: President, H. B. Reed, Westinghouse Air Brake Co.; vice president, O. Edwin Decker, Acheson Mfg. Co.; secretary-treasurer, E. P. Buchanan, Pittsburgh Coke & Chemical Co.—*J. C. Sullivan.*

Quad City

ANNUAL outing of Quad City Chapter of the AFS was held at Camp Nobel on Rock river June 17. Approximately 200 members and guests participated in the golf tournament and games featured during the day. This was topped off with a chicken dinner and entertainment. Those attending were asked to guess the weight of a casting display. *Guessing* was done since answers varied 100 lb on a 45 lb total.—*R. E. Miller, John Deere Planter Works.*

Chesapeake

FINAL meeting of the season for Chesapeake Chapter of the AFS was held May 26 at the Engineers Club, Baltimore. Max Kuniansky, vice president and general manager, Lynchburg Foundry & Machine Co., Lynchburg, Va., presented that company's sound movie entitled, "Men and Molds," which illustrates making molds and cores under modern foundry practice.

Roundtable discussions on iron and nonferrous foundry practices featured the meeting. Mr. Kuniansky presided at the ferrous session at which most of the discussion centered around nodular cast iron. Emphasis was placed on the need for a foundry metallurgist to cope with and control the many problems constantly present in the production of this new material. Defective castings are apt to arise from improper gating and risering and impurities in the iron.

Nonferrous roundtable was conducted by David Tamor, American Chain & Cable Co., Reading, Pa. Advantages of generous filleting were discussed along with relative merits of coke, oil, and gas fuels. Also considered were the dangers of water vapor present in new furnace patches and ladle linings as well as the causes of inverse segregation on lead-tin bronzes.

At the May 26 meeting officers and directors of the chapter elected to serve during the coming year were: Chairman, A. A. Hochrein, resident manager, Federated Metals Division, American Smelting & Refining Co.,

(*Continued on page* 158)

WESTERN MICHIGAN Chapter of the AFS held a dinner for committee chairmen for the chapter's annual stag picnic planned for Aug. 19 at Pontaluna Golf Club, Muskegon, Mich. Golf, prizes, dinner and floor show are scheduled. Photo by Frank Beetham, Campbell, Wyant & Cannon Foundry Co.

The perfect green bond...

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MOGUL cuts down discards

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Write Technical Sales Department

CORN PRODUCTS
REFINING COMPANY
17 Battery Place • New York 4, New York

—— *the preferred dry bond for cores*

(*Continued from page* 156)

Baltimore; vice chairman, Allen S. Kittrell, owner, Leach Pattern Shop, Baltimore. Clausen E. Robeck, vice president, Gibson & Kirk Co., Baltimore, was re-elected secretary-treasurer as was Technical Secretary William H. Baer, Naval Research Laboratory, Washington.

Directors elected for three years: J. W. Mentzer, salesman, Lancaster, Pa.; Eugene H. Ryer, superintendent, James J. Lacy Co., Baltimore, and J. Brownlee Mentzer, secretary-treasurer, Wood Embly Brass Co., Waynesboro, Pa., retiring chairman.—*C. A. Robeck, Gibson & Kirk Co. and Jack H. Schaum, National Bureau of Standards.*

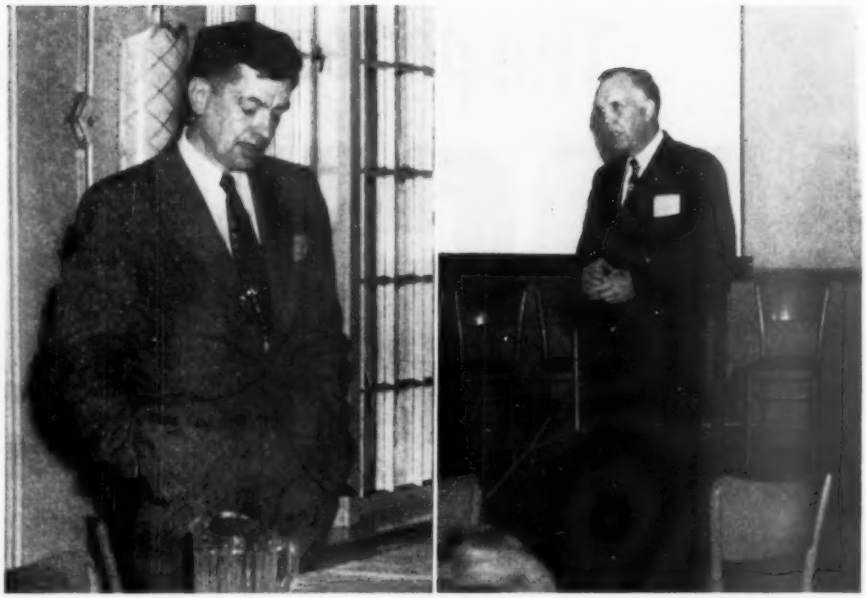
Central New York

ELECTION of officers and directors was held at the May 10 meeting of Central New York Chapter of the AFS held at the Onondaga Hotel, Syracuse, N. Y. Unanimously elected were: Chairman, David Dudgeon Jr., Utica Radiator Corp., Utica, N. Y.; vice chairman, William D. Dunn, Oberdorfer Foundries, Syracuse; secretary, Donald J. Merwin, Oriskany Malleable Iron Co., Utica; treasurer, J. Francis Dobbs, New York Air Brake Co., Watertown, N. Y. Directors elected to serve three years are: Bruce Artz, Pangborn Corp., Syracuse; John F. Livingston, Crouse-Hinds Co., Syracuse; and George E. Hochgesang, Straight Line Foundry & Machine Corp., Syracuse.

Retiring Chairman Livingston described the foundry course being established at Syracuse University, and presented a check to Dr. Morral, representing the Engineering College of the university, to aid in the purchase of necessary equipment. At the same time he offered the services of chapter members in laying out the foundry and in solving any problems.

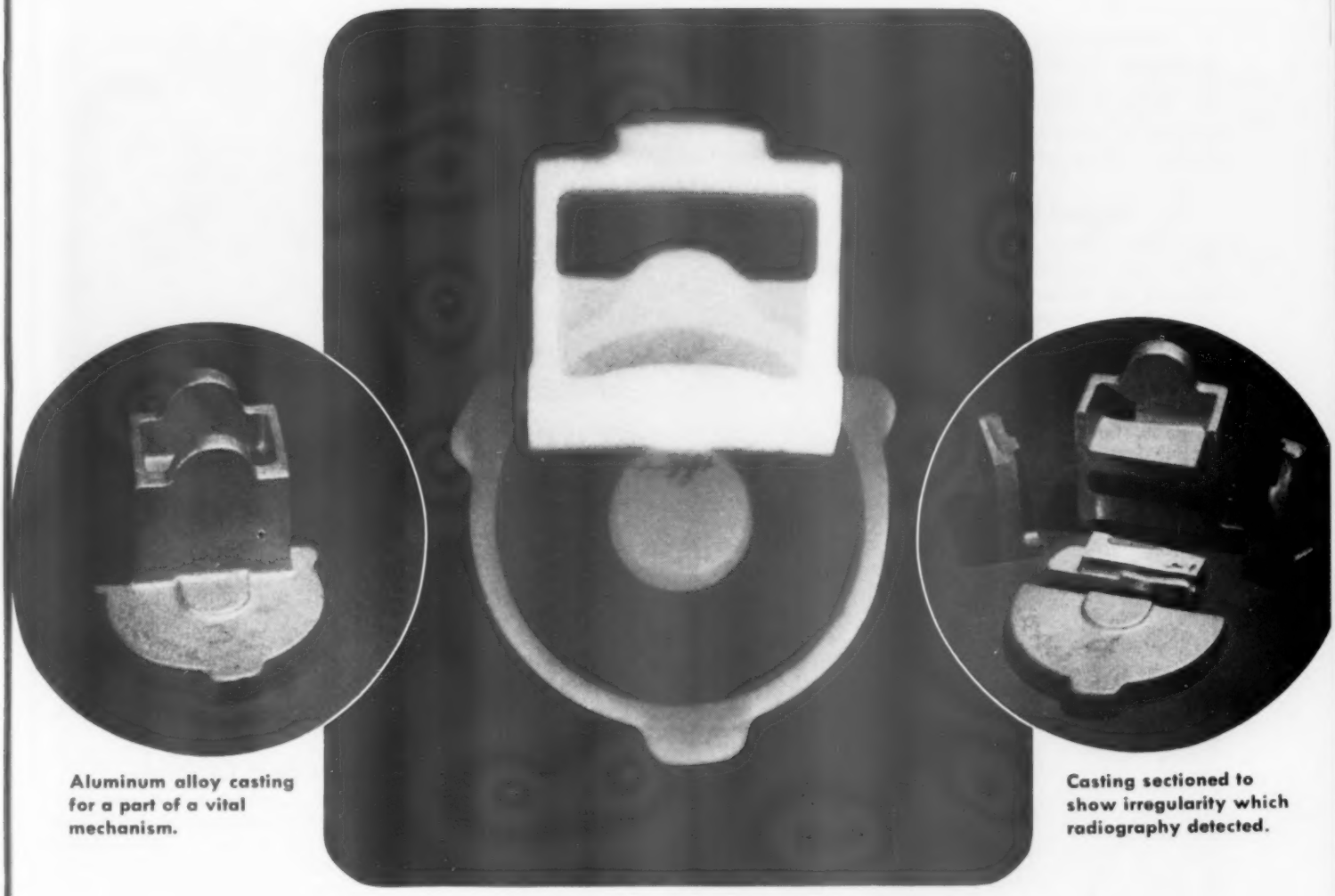
Principal speaker at the meeting was the late R. G. McElwee, Vana-

(*Continued on page* 160)



CENTRAL OHIO Chapter of the AFS had two speakers at its May meeting. At left is D. E. Krause, executive director Gray Iron Research Institute, Columbus, O. L. W. Eastwood, supervisor, Battelle Memorial Institute, Columbus, is at right. Photos are by courtesy of Wilfred White, Jackson Iron & Steel Co.

CENTRAL NEW YORK Chapter of the AFS met at the Onondaga Hotel, Syracuse, N. Y., May 19. At left is the late R. G. McElwee, Vanadium Corp. of America, Detroit, principal speaker at the meeting. Below, left to right, are: Harold Boardman, General Electric Co., Elmira, N. Y.; William Dunn, Oberdorfer Foundries, Syracuse; J. F. Livingston and J. O. Ochsner, Crouse-Hinds Co., Syracuse; Francis Dobbs, New York Air Brake Co., Watertown, N. Y.; Dave Dudgeon, Utica Radiator Co., Utica, N. Y.; George Hochgesang, Straight Line Foundry & Machine Corp., Syracuse, and John A. Feola, Crouse-Hinds Co.



Aluminum alloy casting for a part of a vital mechanism.

Radiograph which revealed imperfection in the casting.

Casting sectioned to show irregularity which radiography detected.

Radiography helps prevent delays in production

ALONG with scores of other castings, this one becomes part of an intricate mechanism. Extremely high quality is a must. Machining is long, complicated, and precise. Should the casting be imperfect, not only the piece and the machining time are lost—the flow of finished parts is disrupted and a whole assembly line delayed.

This is why it pays the foundry well to check the casting radiographically. It is the one way any foundry can be certain it releases only sound castings. And, equally important, it is a way that not only detects irregularities but, at the same time, indicates ways to revise gating, venting, pouring temperature, and other variables which influence consistently good work.

Ask your X-ray dealer to explain the many ways radiography can increase your yield and cut your costs.

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Radiography...

another function of Photography

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(*Continued from page* 158)
dium Corp. of America, Detroit, who discussed cupola research projects and recent developments in the production of nodular iron.—*John A. Feola, Crouse-Hinds Co.*

Central Indiana

SEVEN past chairmen of Central Indiana Chapter of the AFS were honored at dinner which preceded the May 12 meeting. Principal speaker was Ray A. Witschey, ceramic engineer, A. P. Green Fire Brick Co., Mexico, Mo., who was introduced by C. C. Spencer, Electric Steel Castings Co., Indianapolis, the meeting's technical chairman.

Announcement was made of the officers elected to serve during 1950-51. New chairman is Allen J. Reid, General Refractories Co., Indianapolis; vice chairman, Robert Spurgin III, Swayne, Robinson & Co., Richmond, Ind.; Fred Kurtz, Electric Steel Castings Co., Indianapolis; treasurer, Ray Fickenworth, C. & G. Foundry & Pattern Works, Indianapolis. Directors to serve three years are: W. K. Mitchell, L. W. & W. K. Mitchell Co., Indianapolis; Dallas Lunsford, Perfect Circle Co., New Castle, Ind.; Jean Danenfelser, International Harvester Co., Indianapolis; and E. G. Richardson, Delco-Remy Division, General Motors Corp., Anderson, Ind. —*W. K. Mitchell.*

SOUTHERN CALIFORNIA Chapter of the AFS met at Rodger Young Auditorium, Los Angeles, May 19. Shown at the speakers' table at the meeting, left to right, are: Harold Pagenkopp, Angelus Pattern Works, Huntington Park, Calif., chapter secretary; Henry W. Howell, Howell Foundry Co., Los Nietos, Calif., vice president elect; E. K. Smith, consulting metallurgist; Robert Gregg, Reliance Regulator Corp., Alhambra, Calif., national AFS dircetor; J. A. Dickson, Dickson Foundry Co., Canada, chairman of British Columbia Chapter of the AFS, and Henry E. Russill, Eld Metal Co., Los Angeles, past president

Southern California

A large attendance of members and friends together with student entrants in the chapter's essay contest and their instructors were

(*Continued on page* 162)

CENTRAL INDIANA Chapter of the AFS elected officers and directors at its May 12 meeting. At top S. F. Swain (left), Golden Foundry Co., Columbus, Ind., retiring chairman, congratulates incoming chairman Allen J. Reid, General Refractories Co., Indianapolis. Center, C. C. Spencer (left), Electric Steel Castings Co., Indianapolis, greets Ray A. Witschey, A. P. Green Fire Brick Co., Mexico, Mo., speaker at the meeting. At bottom is a group of past chapter chairmen who attended the meeting. Left to right: Robert Langsenkamp, Langsenkamp-Wheeler Brass Works, Indianapolis; Harold Lurie, Cummins Engine Co., Columbus, Ind.; Richard Bancroft, Perfect Circle Corp., Hagerstown, Ind.; J. P. Lentz, International Harvester Co., Indianapolis; Ray S. Davis, National Malleable & Steel Castings Co., Indianapolis; B. P. Mulcahy, consultant, Indianapolis, and I. R. Wagner, Electric Steel Castings Co., Indianapolis. Photos by courtesy of staff photographer, International Harvester Co.

NEW IDEAS

For Faster Production - - and Lower Costs

Take For Example —

the 8 gang dump box shown in the unretouched photograph above, measuring 13½ x 9½ x 2½ and weighing only 12 pounds, was made from the single wood master core plug and backing frame. The price, believe it or not, about $36.00.

Also made by the same method are two part split or booked core boxes with flat or irregular partings together with properly cleared white metal master dryer patterns.

There is profit in this idea for you. Hundreds of foundries are now using this modern streamlined method of making core boxes and master dryers because it is accurate, saves machining and offers large savings in the intricate and gang type core box.

Your inquiry will receive prompt attention.

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NATIONAL CASTINGS COUNCIL held its annual meeting May 10 at Hotel Cleveland, Cleveland. Shown at the meeting, seated, left to right, are: Edwin W. Horlebein, Gibson & Kirk Co., Baltimore; Frank G. Steinebach, The FOUNDRY, Cleveland; Collins L. Carter, Albion Malleable Iron Co., Albion, Mich.; Henry J. Trenkamp, Ohio Foundry Co., Cleveland. Standing, left to right: Walter M. Clark, D. W. Clark & Co., South Boston, Mass.; Franklin Farrel 3rd, Farrel-Birmingham Co. Inc., Ansonia, Conn.; Harry E. Ladwig, Allis-Chalmers Mfg. Co., Milwaukee; John Hellstrom, American Air Filter Co., Louisville; Walton L. Woody, National Malleable & Steel Castings Co., Cleveland; Frank B. Flynn, S. Obermayer Co., Chicago; and E. D. Flintermann, Michigan Steel Casting Co., Detroit

(*Continued from page* 160)
present at the May 19 meeting of Southern California Chapter of the AFS. Also, James A. Dickson, Dickson Foundry Co., Vancouver, B. C., and chairman of the British Columbia Chapter, was a guest of the chapter.

Speaker was Chester V. Nass, vice president, Beardsley & Piper Division of Pettibone Mulliken Corp., Chicago, whose subject was "Progress in Mulling of Foundry Sands." His talk was prefaced with a showing of a color motion picture.

Mr. Nass pointed out that in addition to mixing bond with sands, mullers also more evenly distribute grain sizes, thus reducing scrap and producing castings with smoother finish and lower cleaning costs. Also, less bonding materials are needed with thorough sand mulling. The speaker stressed the importance of having accurate containers and mixture measurements and a dependable muller operator.

Election of the following officers was announced: President, John E. Wilson, Climax Molybdenum Co. of Michigan, Los Angeles; vice president, Henry Howell, Howell Foundry Co. Inc., Los Nietos, Calif.; secretary, Harold G. Pagenkopp, Angelus Pattern Works, Huntington Park, Calif., and treasurer, A. L. Goodreau, G.-B. Brass & Aluminum Foundry, Los Angeles. Directors elected include: Emile Peschke, Reliance Regulator Corp., Alhambra, Calif.; William Mitchell, Utility Electric Steel Foundry, Los Angeles; Kenneth Miller, K. W. Miller Patterns; and R. J. Wallace, Westlectric Castings Inc., Los Angeles.

Final meeting of the current season for Southern California Chapter of the AFS was held June 9 at Rodger Young Auditorium, Los Angeles. Retiring president Earle Shomaker, Kay-Brunner Steel Products Inc., presented his annual report and introduced John E. Wilson, Climax Molybdenum Co. of Michigan, incoming president.

Robert Gregg, Reliance Regulator Corp., the chapter's first president and a national director of the AFS, reviewed the progress made by the chapter since its beginning. Mr. Shomaker was presented a ring, a chapter custom, by Leonard Hofstetter, Brumley-Donaldson Co., a past chapter chairman.

At the conclusion of the business meeting, a motion picture on smog control was shown.—*W. G. Stenberg, U. S. Electrical Motors Inc.*

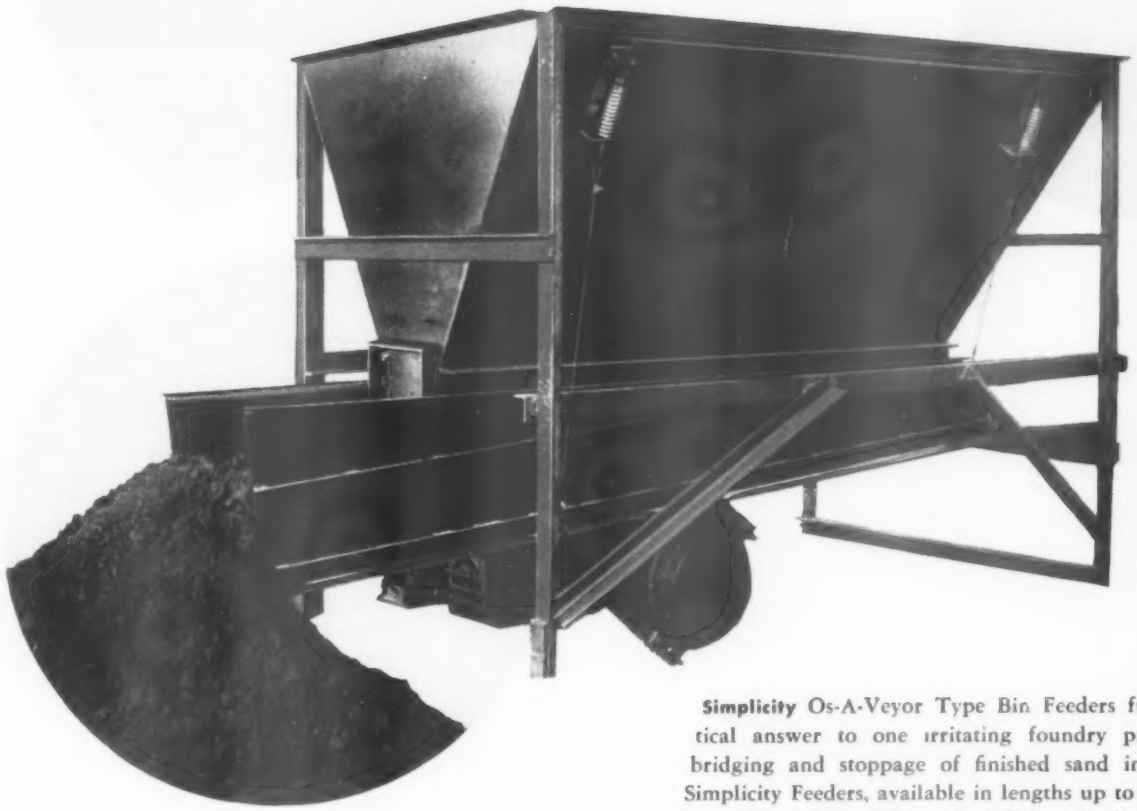
WISCONSIN Chapter of the AFS had a number of past presidents at the recent national foundry convention and show in Cleveland. Shown above, front row, left to right, are: Walter Gerlinger, Walter Gerlinger Inc., Milwaukee; W. J. MacNeill, Dayton Malleable Iron Co., Dayton, O., and Ben Claffey, Acme Aluminum Alloys Inc., Dayton. Back row, left to right: George K. Dreher, Foundry Educational Foundation, Cleveland; H. E. Ladwig, Allis-Chalmers Mfg. Co., Milwaukee; John Bing, Metropolitan Refractories Corp., New York, and Dave Zuege, Sivyer Steel Casting Co., Milwaukee. Not included in the photo are: Roy M. Jacobs, Standard Brass Works, Milwaukee; R. J. Anderson, Belle City Malleable Iron Co., Racine, Wis.; R. C. Woodward, Bucyrus-Erie Co., South Milwaukee, Wis., and A. C. Ziebell, Universal Foundry Co., Oshkosh, Wis. Photo is by courtesy of John Bing, Metropolitan Refractories Corp.

Wisconsin

ANNUAL meeting of Wisconsin Chapter of the AFS honoring old timers and apprentices was held June 13 at the Schroeder Hotel, Milwaukee. Seven new members were added to the ranks of the Old Timers, men who have worked in foundries for a total of 50 years, and the total

(*Continued on page* 164)

SIMPLICITY OS-A-VEYOR BIN FEEDER REDUCES BRIDGING AND STOPPAGE



2′ x 10′ two-surface Os-A-Veyor Type Feeder Installed Under Test Bin.

Simplicity Os-A-Veyor Type Bin Feeders furnish a practical answer to one irritating foundry problem . . . bridging and stoppage of finished sand in storage bins. Simplicity Feeders, available in lengths up to 50′ and widths from 12″ to 6′, *feed from the full length of the bin* with the danger of bridging and hanging greatly reduced. Sand also can temper in the bin with exact length of time dependent on capacity of bin and rate of feed. ↓ ↓ ↓ In actual operations, a 3′ x 17′ two-surface Simplicity Bin Feeder installed at the Buick foundry, Flint, Michigan, handles, *at a uniform controlled rate*, 100 tons per hour of finished, mulled and tempered sand feeding from a 150 ton capacity bin through a 14′ long opening. In this operation, the sand is allowed to temper for 1½ hours before going to the molders. Greater capacities are readily possible if required. ↓ ↓ ↓ Why not investigate Simplicity Os-A-Veyor type bin feeders for your foundry . . . *it'll mean money saved.* A Simplicity sales engineer will be glad to give you the full story on the remarkable new development.

84

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TRADE MARK REGISTERED

ENGINEERING CO. • DURAND, MICHIGAN

(*Continued from page* 162)
membership is now 127.

Twelve contestants in the chapter's apprentice contest who won prizes were presented certificates. Three of this group also won prizes in the national apprentice contest.

Retiring President Robert Woodward, Bucyrus-Erie Co., introduced Walter W. Edens, Badger Brass & Aluminum Foundry Co., the incoming president. As a memorial to William F. Bornfleth, the chapter's first president who died Apr. 21, a resolution was adopted by the chapter citing Mr. Bornfleth for his leadership and service to the chapter.

After dinner a good floor show was presented to conclude the season's activities.—*John E. Hubel*

TENNESSEE Chapter of the AFS elected officers and directors May 26 at Hotel Patten, Chattanooga, Tenn. Above, left to right, are: Karl Landgrebe, Wheland Co., Chattanooga, retiring chairman; E. C. Jeter, Ford Motor Co., Dearborn, Mich., speaker, and Paul Arnold, U. S. Pipe & Foundry Co., Chattanooga, chairman-elect

Northwestern Pennsylvania

APPROXIMATELY 100 members and guests were present at the May 22 meeting of Northwestern Pennsylvania Chapter of the AFS held at the Moose Club, Erie. A talk entitled "Cracks and Tears in Ferrous Castings" was presented by B. C. Yearly, assistant manager of the Cicero, Ill., plant of National Malleable & Steel Castings Co.

Mr. Yearly stated there are two kinds of cracks in castings—high-temperature hot tears or shrink cracks and low-temperature strain or cold cracks caused by forces in the casting stronger than the material's ultimate strength. Most high-temperature cracks are caused by the metal, gating, cores and molding sand. Molds must allow castings to contract or stretch at all times, and temperature differences should be eliminated as much as possible.

Chairman Shuffstall announced the following officers had been elected: Chairman, Frank P. Volgstadt, Griswold Mfg. Co., Erie; vice chairman, Douglas James, Cooper-Bessemer Corp., Grove City, Pa.; secretary, Earl M. Strick, Erie Malleable Iron Co., Erie; treasurer, Fred Carlson, Weil-McLain Co., Erie. Directors to serve three years are: C. S. Ban, American Brake Shoe Co., Meadville, Pa.; Duane P. Davis, Urick Foundry Co., Erie; Bailey D. Herrington, Hickman, Williams & Co., Erie. Retiring Chairman Joseph Shuffstall, National Erie Co., Erie, continues as director for one year.

The chapter's annual picnic is scheduled for Tyman's Grove, Erie, on Saturday, Sept. 16.—*Earl M. Strick, Erie Malleable Iron Co.*

NORTHWESTERN PENNSYLVANIA Chapter of the AFS elected new officers at its May 22 meeting at the Moose Club, Erie, Pa. Front row, left to right, are: Joseph Shuffstall, National Erie Corp., Erie, immediate past chairman and new director; B. C. Yearly, National Malleable & Steel Castings Co., Chicago, speaker, and Frank Volgstadt, Griswold Mfg. Co., Erie, chairman-elect. Back row, left to right, are: Earl M. Strick, Erie Malleable Iron Co., Erie, secretary; Douglas James, Cooper-Bessemer Corp., Grove City, Pa., vice chairman; Fred Carlson, Weil-Mclain Co., Erie, treasurer, and Bailey Herrington, Hickman, Williams & Co., Erie, director

Tennessee

FIFTY-SEVEN members and guests of Tennessee Chapter of the AFS attended the final meeting of the year at Hotel Patten, Chattanooga, May 26. After receiving reports of committees for the past year, Chairman Landgrebe held election of officers and directors. Those elected are: Chairman, Paul Arnold, U. S. Pipe & Foundry Co., Chattanooga; vice chairman, Porter Warner Jr., Porter Warner Industries; secretary-treasurer, Herman Bohr Jr., Robbins & Bohr. Directors elected to serve one year include: Karl Landgrebe, Wheland Co.; William P. Delaney, Eureka Foundry Co.; Charles B. Saunders, Tennessee Products & Chemical Corp.; D. B. Shannon, Somerville Iron Works. Those elected to two-year terms are: S. C. Northington, Combustion Engineering Co., D. H. L. Bealer, American Brake Shoe Co. Directors elected to serve three years are: W. P. Willson, Athens

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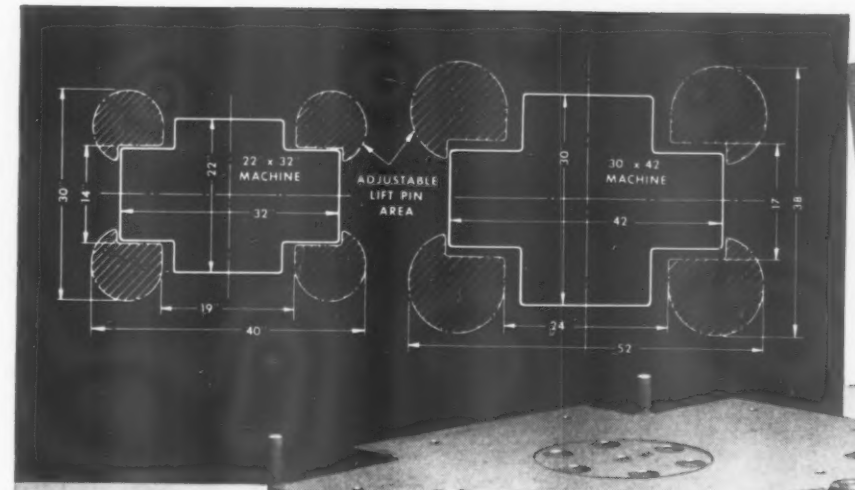
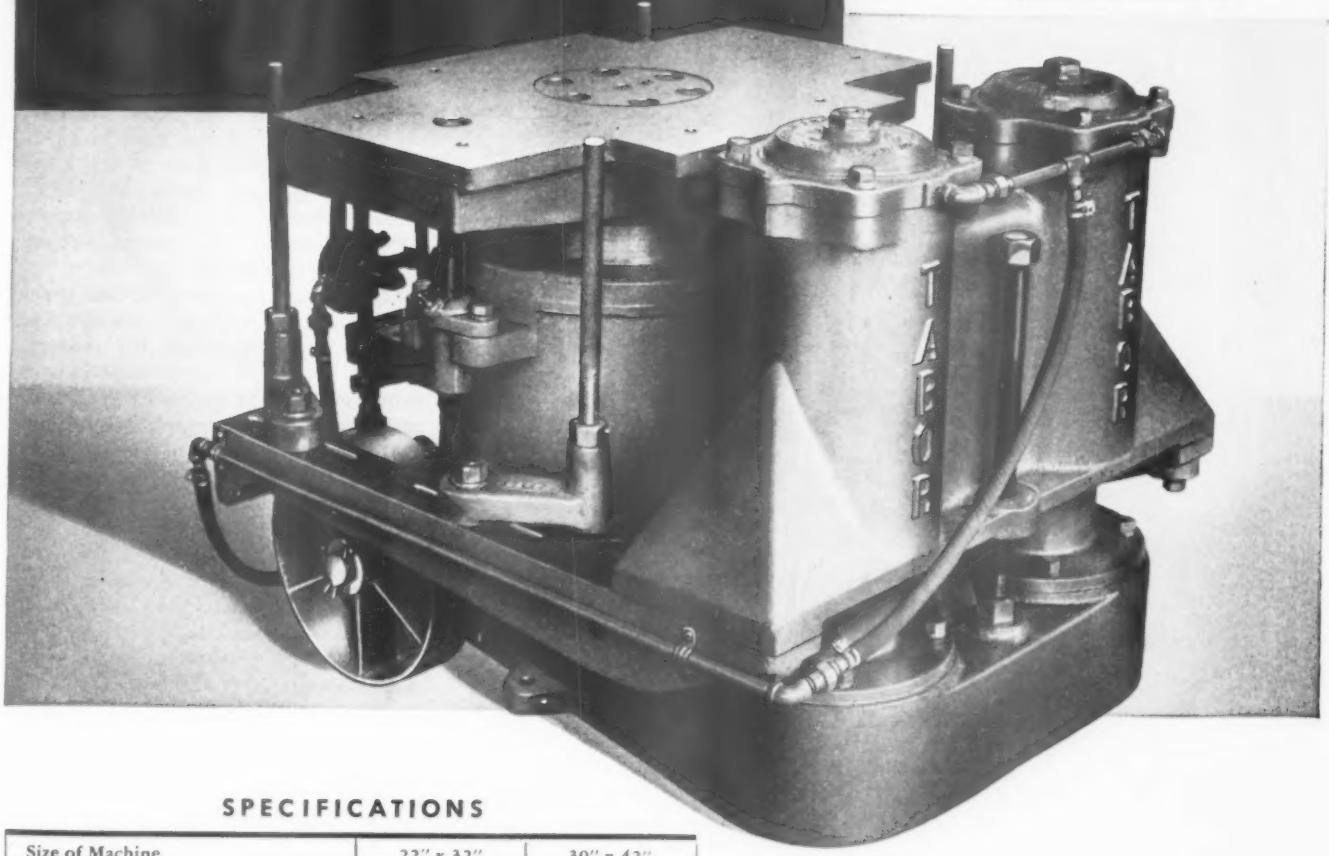


Tabor

JAR FLASK LIFT MACHINE

Equipped with Adjustable Lift Pins



SPECIFICATIONS

Size of Machine	22″ x 32″	30″ x 42″
Table Size	22″ x 32″	30″ x 42″
Capacity—80# Air	600#	1000#
Patt. Draw.—Plain Jar	10″	12″
Patt. Draw.—Shockless	9″	12″
Lift Pin Adjustment	See cut	See cut
Max. Width Flask with Center of Flask on Center of Jar Mach.	30″	38″
Min. Width Flask	14″	17″
Max. Length of Flask	Unlimited within capacity of machine	
Patt. Draw.	Oil Controlled—Slow & Fast	
Height Table from Floor—Portable	28″	32″
" " " " Stationary	26″	30½″
Portable Mach. 3 Wheels	12″ Dia. 3″ Face 14″ Dia. 4″ Face	
Stationary Mach.	3 Foundation Bolts	
Weight Shockless Jar	2600#	4000#
Weight Plain Jar	1900#	2700#

THESE new Tabor Flask Lift Machines allow working access from three sides. Flask-lifting pins are adjustable for different lengths and widths of pattern plates, thereby covering a wide range of flask sizes. Machines are furnished either plain or shockless jar, in two table sizes—either stationary or portable. We will be glad to send prices and further information at your request.

REPRESENTATIVES
Snyder Foundry Supply Company, Los Angeles, Calif.; The Pacific Graphite Company, Inc., 40th & Linden Sts., Oakland 8, Calif.; Carl F. Miller & Company, Seattle, Washington; E. R. Frost Company, Inc., Minneapolis 14, Minn.; Harry H. Reich, Trussville, Ala.

FOUNDRY EQUIPMENT MANUFACTURERS ASSOCIATION INC. MEMBER FEMA

The TABOR *Manufacturing Co.*

SINCE 1884 MANUFACTURERS OF FOUNDRY MOLDING MACHINES
6225 TACONY STREET • PHILADELPHIA 35, PENNA.
EXPORT DEPARTMENT, 751 DREXEL BLDG., PHILADELPHIA 6, PA.

(*Continued from page* 164)

Plow Co., and W. M. Hamilton, Crane Co.

Mr. Warner introduced E. C. Jeter, plant manager, Ford Motor Co. production foundry, Dearborn, Mich., whose topic was, "Metallurgy and Production of Gray Iron Castings."

Before the advent of the automobile, according to Mr. Jeter, most gray iron was for stove plate, heavy machinery and agricultural castings where metallurgy wasn't considered as important as it is today. With the coming of the internal combustion engine, the gray iron industry, of necessity, changed to a science, which includes the correct melting, mixing and blending of materials to make gray iron castings the highly dependable and useful products they are today.

Mr. Jeter pointed out that the most exacting task required in any industry is to secure the right materials and then use them in a manner to get maximum benefit. No other industry has to cope with as many possible variables as foundrymen. The speaker then described Ford's method of melting iron for cylinder blocks, mixing blast furnace and cupola iron for the composition desired. Mr. Jeter also showed slides illustrating various defects which had been encountered, and he then described the method employed to correct them.—*Carl A. Fischer Jr., Fischer Supply Co.*

Tri-State

NONFERROUS foundrymen and guests met at Hotel Lassen, Wichita, Kans., for the Apr. 21 meeting of Tri-State Chapter of the AFS. Speaker was R. A. Colton, Federated Metals Division of American Smelting & Refining Co., whose subject was "Bronze Casting Defects."

Mr. Colton illustrated various types of defects in nonferrous castings and explained the cause and the remedy. A main point of the discussion was formation of gas holes by hydrogen and oxygen. The speaker pointed out that melting practice has a great bearing on the two elements and that defects can be reduced with proper melting control.

C. A. McNamara Jr., Big 4 Foundry Inc., Tulsa, Okla., and chapter chairman, announced the following officers had been nominated for the coming year: Chairman, F. E. Fogg, Acme Foundry & Machine Co., Cof-

(*Concluded on page* 168)

NORTHEASTERN OHIO Chapter of the AFS held old timers' and past presidents' night, and election of officers and directors, May 25 at Tudor Arms Hotel, Cleveland. Top photo shows Walton L. Woody (left), National Malleable & Steel Castings Co., Cleveland, first president of the chapter (1935-36) and national AFS president, who received a brief case from chapter members in recognition of the latter honor. At right is William G. Gude, managing editor, *The Foundry*, retiring chapter president, who made the presentation. Lower photo shows a group of Aluminum Co. of America old timers. First row, left to right, are: Mat Moenich, Joseph Reitz, Dave Mason, Joseph Lester, John Veres, and James Mobberly. Back row: George Gedeon, William Gedeon, William Volmar, John Stefanko, Joseph Timko, John Tommer, Bert Sabo, and Adolph Jiminez. Photos courtesy of Aluminum Co. of America

LIGHTWEIGHT

INSURE PRECISION . . .
SPEED-UP PRODUCTION

• Twenty years have proved the welded steel flask. Millions of castings in foundries the world over have been poured . . . perfectly. That's because welded steel won't shift so easily, permits far greater precision, stands up under hardest conditions.

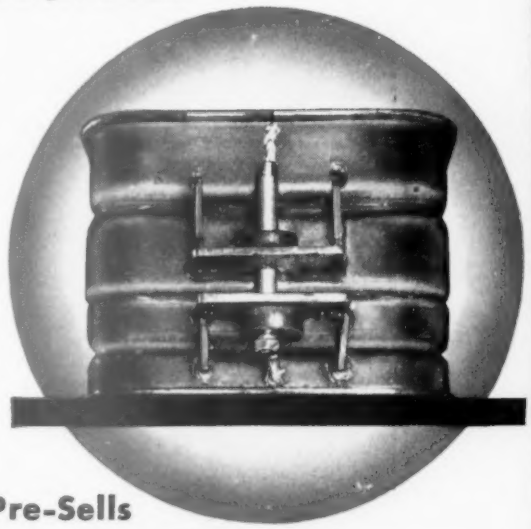
BS&B developed the welded steel flask . . . pioneered the steel-bushed flask. Now even the most exacting job moves faster because of the ease of working with the strong, sturdy steel flask. Far easier to handle, too . . . they are so much lighter.

No matter the metal, regardless of close tolerance, BS&B Flasks mean better castings, faster!

BS&B
Fabricated Steel
FOUNDRY FLASKS

BUILT
for the Foundry
by Foundrymen!

Yes, sir . . . every step in the manufacture of BS&B Flasks is controlled by FOUNDRYMEN. It is the skill and experience of such men that have led to so many improvements in material and method. For instance, the pinlugs pictured at the right. Just a simple reversal of the upper, and the foundryman has plenty of room for his fingers . . . the pinlug serves as a handle. Such planning, combined with manufacturing skill, is why BS&B Flasks do not require stress-relieving or normalizing, and will not warp under even extreme conditions of use.



BS&B Pre-Sells Your Customer!

We advertise you every time we advertise in STEEL, IRON AGE and PURCHASING. Our ads are addressed to the buyer of castings . . . selling him on your skill and precision with BS&B Flasks. It's another BS&B service!

Call your nearest BS&B DISTRIBUTOR TODAY

BIRMINGHAM, ALA.
Foundry Service Co.
BOSTON, MASS.
Klein-Farris Co., Inc.
SEATTLE, WASH.
Carl F. Miller & Co.
CHICAGO, ILL.
S. Obermayer Co.
CINCINNATI, OHIO
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C. L. Nash
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E. J. Woodison Co.
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Canadian Foundry Sup. & Equipment, Ltd.
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Yours without cost! Complete catalog, fact book, handy reference.

BLACK, SIVALLS & BRYSON, INC.
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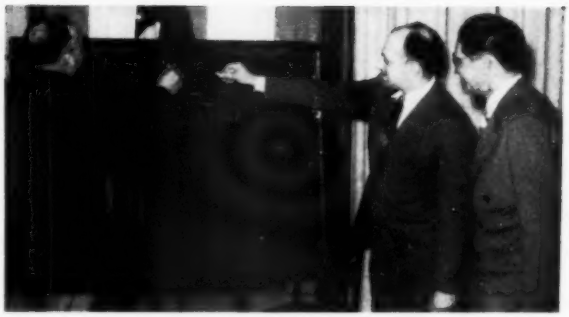
(*Concluded from page* 166)

feyville, Kans.; vice chairman, D. A. Mitchell, Progressive Brass Mfg. Co., Tulsa; secretary, C. C. Beagle, Webb Corp., Webb City, Mo.; and treasurer, D. W. McArthur, Oklahoma Steel Castings Co., Tulsa.—*Dale Hall, Oklahoma Steel Castings Co.*

Reading

MOLDING and Core Sand Control through Binder Selection" was discussed by Dr. Earl E. Woodliff, foundry sand engineer, Detroit, at the May 16 meeting of the Reading Foundrymen's Association held at the Berkshire Hotel, Reading, Pa.

Dr. Woodliff discussed the advantages and disadvantages of various binders in molding sand.—*W. I. Cassidy.*



TRI-STATE Chapter of the AFS met at Hotel Lassen, Wichita, Kans., Apr. 21. Left to right are: Frank R. Westwood, Service Foundry Co., Wichita; R. A. Colton, Federated Metals Division, American Smelting & Refining Co., New York, speaker, and J. G. Timmons

Central Illinois

FOURTH annual clambake of Central Illinois Chapter of the AFS was held June 10 at the 40 and 8 Chateau near East Peoria, Ill. In addition to clam juice, shrimp, baked clams, chicken and vegetables, music and entertainment were featured as part of the festivities.—*John R. Nieman, Caterpillar Tractor Co.*

NORTHERN CALIFORNIA Chapter of the AFS completed its fiscal year in June. At top, left to right, are: Edwin Brumley, Brumley-Donaldson Co.; Ed Rowe, Balfour Guthrie Co..; Pete Valentine Jr., Del Monte Properties Co., and Jay Snyder, National Grinding Wheel Co., conferring over results of ladies' night, June 17 at Orinda Country Club. Lower photo shows a group at the June chapter meeting at Villa De La Paix, Oakland, Calif. Front row, left to right, are: C. V. Nass, Beardsley & Piper Division, Chicago, the speaker, and John Russo, Russo Foundry Equipment Co., chapter president elect. Back row: James Francis, Vulcan Steel Foundry Co., retiring chapter president; Phil Rodger, General Metals Corp., incoming program chairman and Davis Taylor, American Wheelabrator & Equipment Co., secretary elect. Photos by courtesy of "Pen" De Roche Jr., *Western Machinery & Steel World*

Around the Country
Pittsburgh Area

(*Concluded from page* 122)

ing castings and others supplying castings for Diesel engines, machine tools and other heavy electrical equipment, and freight car building program. Little change in business activity from near capacity pace has occurred among foundries making castings for enamel ware trade, fittings, etc.

Reported rumor in last month's issue that Fort Pitt Malleable Iron Company may re-open under new management has proven partially accurate in that the concern has been purchased by Steel Trading Corporation, Pittsburgh. This last malleable iron interest in greater Pittsburgh area discontinued operations March 31, and employed about 500 men shortly prior to closing. Whether the re-opening feature of the rumor materializes depends on results of surveys and engineering studies of the facilities currently being carried out by the new owners, according to H. L. Berkman, President, Steel Trading Corporation.

Latrobe Foundry & Machine Company officials are proudly showing visitors company's new and enlarged office quarters these days.

Elects Officers

Electric Metal Makers Guild Inc., at its June meeting elected D. L. Clark, Simonds Saw & Steel Co., Lockport, N. Y., president; C. C. Spencer, Electric Steel Casting Co., Indianapolis, vice president, and R. J. McCurdy, Republic Steel Corp., South Chicago, Ill., secretary - treasurer. Guest speakers at the meeting were W. P. Dudley, Ohio Steel Foundry Co., Springfield, O., and Barton Rees Pogue, poet and philosopher, Upland, Ind.

SAND-MEX®

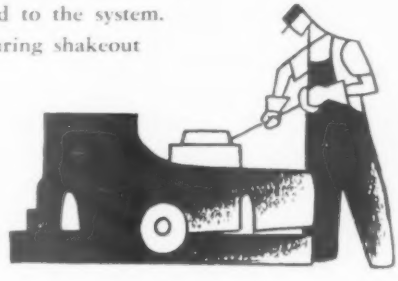
THE IDEAL FOUNDRY SAND CONDITIONER

Sand-Mex is an economical, specially prepared graphite product which, when mixed with foundry sand, increases the flowability and refractoriness of the sand. Sand-Mex is super-refractory, non-gaseous and chemically inert. By coating each grain, Sand-Mex increases stability of the sand and reduces friction between the sand grains. It insulates the sand from chemical or physical contact with the metal, and less expansion and contraction of the sand occurs when the metal is poured into the mold — this means sharper pattern impressions, resulting in castings truer to patterns.

Application: Sand-Mex is easily and economically applied to molding sands at the rate of 40 pounds per ton of sand. Sand-Mex remains permanently in the sand and further additions are made only when new or untreated sand is added to the system. Sand-Mex should be thoroughly mixed, preferably mulled with the sand, in order to obtain best results.

Pouring: Sand-Mex makes molding sand easier to work, gives it greater stability by reducing expansion and contraction in pouring. It prevents chemical reaction between iron oxide and sand, thus helping to eliminate rat-tails, scabs and other defects . . . Sand treated with Sand-Mex, flows more easily and does not hang or bridge in the hoppers — permits all the system sand to be used for molding.

Shakeout: Sand-Mex increases the flowability and collapsibility of sand. This reduces shakeout time to a minimum because the sand has less retained strength, is not so strongly fused, and is more easily broken down. Also, more sand is returned to the system. Damage to casting during shakeout is minimized.



Finishing: Sand-Mex results in cleaner castings with better color and finish. Sand-Mex prevents sand from clinging to the casting — makes cleaning easier. Less finishing time, better castings . . . only two more reasons why Sand-Mex is ideal for foundry use.

THE UNITED STATES GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION • SAGINAW, MICHIGAN

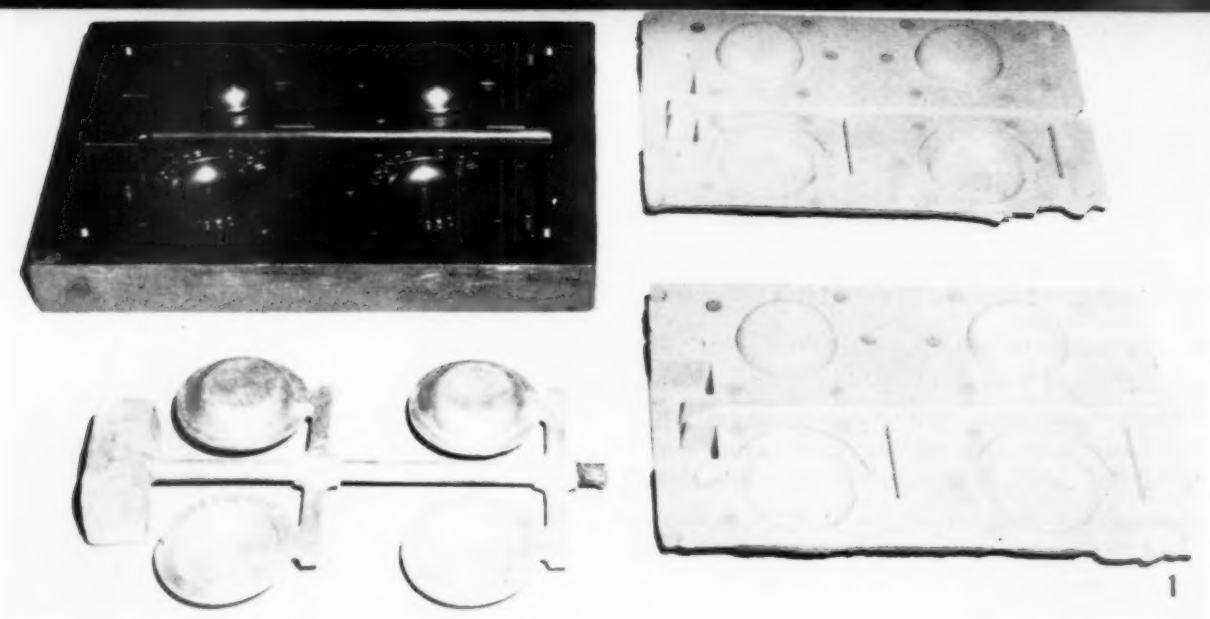
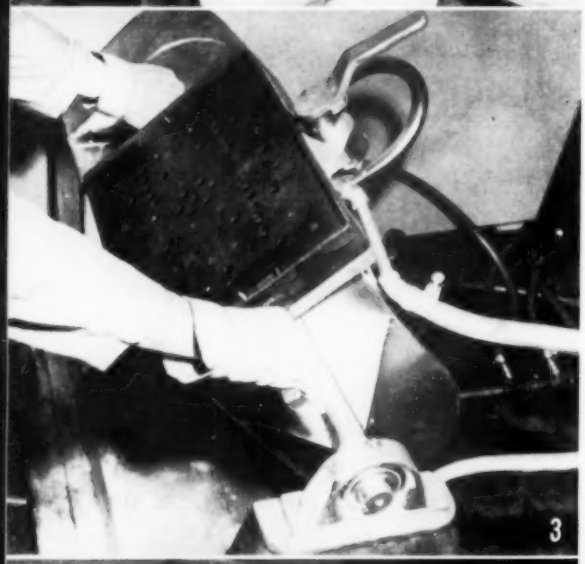


Fig. 1—Casting (lower left) produced in mold halves of type shown at right. Metal pattern at upper left



THE CRONING PROCESS

ACCOMPANYING illustrations depict the principal steps in production of castings by the so-called Croning or "C" process. These views illustrate the operations as demonstrated by the Bakelite Division, Union Carbide & Carbon Corp., at the AFS Foundry Show in Cleveland, May 8-12. The practice shown was based on data supplied by Crown Casting Associates, 75 Federal St., Boston, who have made United States and Canadian patent applications.

No attempt was made in the demonstration to put the operations on a quantity-production basis. In this instance the castings were made of aluminum, although various types of both ferrous and nonferrous metals are said to have been poured successfully into castings weighing up to 100 lb. Principal advantages claimed for castings made by the process are: Close dimensional tolerances (0.002 to 0.003 in.); good as-cast surface; reduction in finishing and machining required, and increased production per unit floor area.

Fig. 2—Mold-making machine being filled with the resin-sand mixture. Fig. 3—Hot pattern is laid on open face of machine and clamped in place. Fig. 4—When machine is inverted resin-sand mixture falls upon hot pattern; heat from pattern causes thin layer of mixture to adhere. Machine is righted and excess mixture falls back into bucket

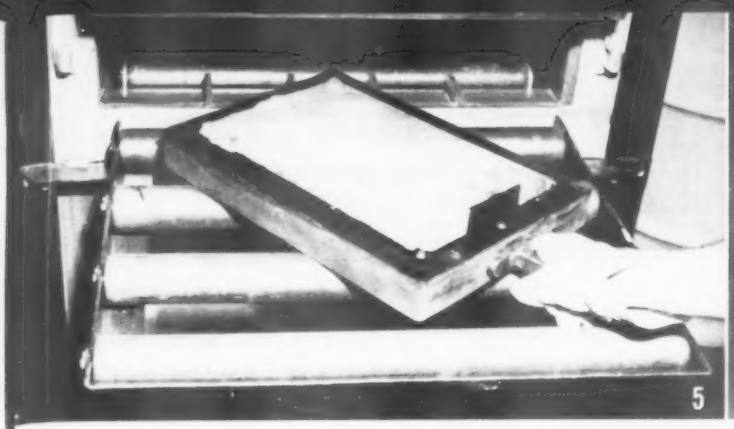


Fig. 5—Pattern and its layer of sand mixture is placed into oven to harden. Fig. 6—After a short bake, the half-mold is removed from pattern by knock-out pins

Fig. 7—Two half-molds are placed face to face to form a mold and clamped together
Fig. 8—Mold is placed in flask; steel shot backing keeps halves from spreading

Fig. 9—Pouring the mold. Fig. 10—Hot metal burns away most of the resin and the mold, although rigid enough to support the casting, is easily removed

Adventures of BILL

By PAT DWYER
Drawings by RICHEY

AT the foundry convention here last May," I said to Bill, "I met a man recently returned from Calcutta, India, where he had been connected with a foundry for several years."

Bill snapped his fingers in the manner of a person whose memory has been given a sudden jolt.

"I suppose," I said, "that means you are going to tell me you did a hitch there at one time in your early touring days."

"As a champion long-distance guesser you are not even in the also-ran class. In this particular instance your reference to Calcutta brought to mind a limerick which I first heard in the old shop where I served my time. Want to hear it?"

"That depends on the classification. I need hardly tell you there are two kinds of limericks: The unprintable (usually the best) and those that may appear on the printed page and that may be quoted freely in the presence of women and children."

"Well," said Bill, "I'll tell you. With a slight change in words, this here now limerick will fit into either class. Here is the printable and quotable version: There was a young man in Calcutta, who wrote naughty words on a shutta. Without more ado, a pious Hindu knocked him head over heels in the gutta!"

"A very commendable and satisfactory gesture. As your worthy uncle Malachi might say, 'More power to his elbow!' However, my friend did not spend all his time quoting limericks. He told me many things connected with the social, political, commercial and industrial life in a country of vast distances, great natural resources, variable climate and a teeming population of approximately 300 million. I'll just give you one illustration.

"The Calcutta office of the world-embracing General Electric Co., better and more familiarly known inside and outside the organization as the *GE*, secured an order from Tibet for an electric plant to furnish light and power to the holy city Lhasa. The prime mover to be a water-driven turbine."

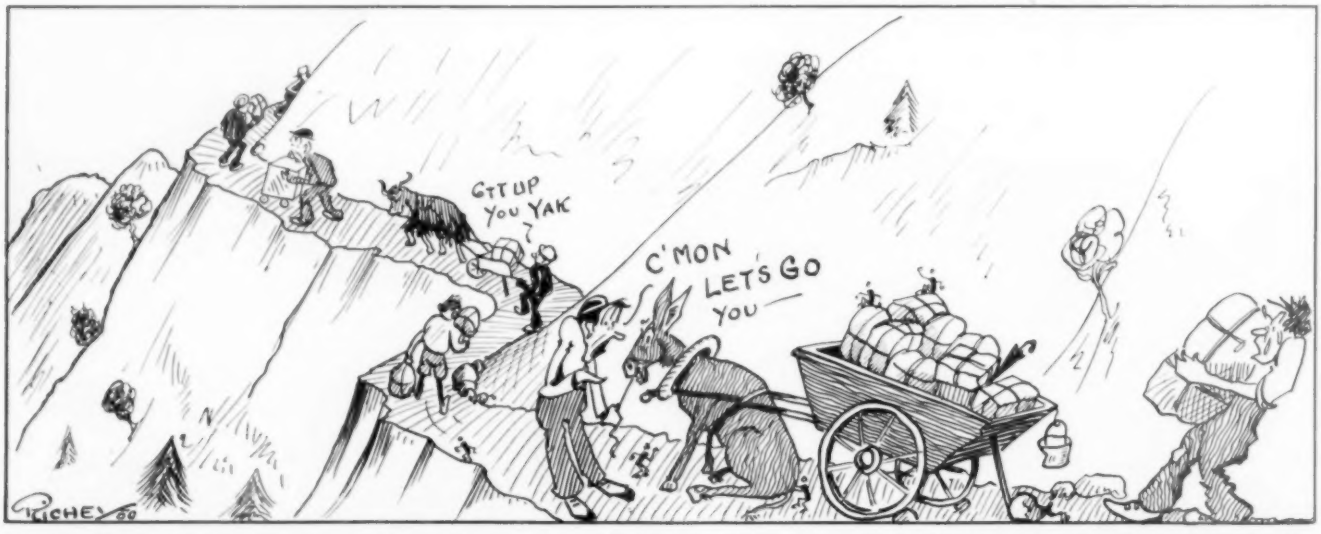
"Lhasa?" Bill said. "Is that another or native name for Shangri-La?"

"No," I explained as politely and patiently as possible. "Shangri-La is an ancient and highly developed scientific and industrialized community where the arts and sciences have been practiced since before the Great Deluge. It lies some distance to the north, or perhaps the south, or the east, or maybe the west of Lhasa."

"With such a complete, precise and accurate road map, one could not miss it. In the meantime you might throw a beam of light on another dark spot. Kindly bend down at least one of your long rabbit ears. Seems to me that when I was a young lad I was told that every living creature, with the exception of Noah and his family and a miscellaneous collection of insects, birds, beasts and reptiles, was drowned in the flood. You probably remember the old song, one of the first on the cylindrical phonograph record: 'The ani-mals came in three by three, the bear, the bug and the bumbly bee. One more river to cross.' Ignoring for the moment the highly improbable ability of Noah and the boys to cope with the feeding and sanitary situation, where does that leave the continuous existence of Shangri-La?"

"High and dry, me boy. This highly favored spot is away up near the top of the Himalaya mountains, and therefore was not flooded. Up there the air is so pure that the inhabitants, a colony of monks, have a life span of several hundred years. A rumor occasionally reaches the outside world to the effect that in their youth two present members of the ancient brotherhood crossed the Pacific Ocean and planted the seeds for the first sequoia trees in California. Unfortunately, the rumor lacks positive or definite confirmation. As a plain matter of fact, it has been boldly challenged by loyal adopted and native West coast sons. They claim the young trees were

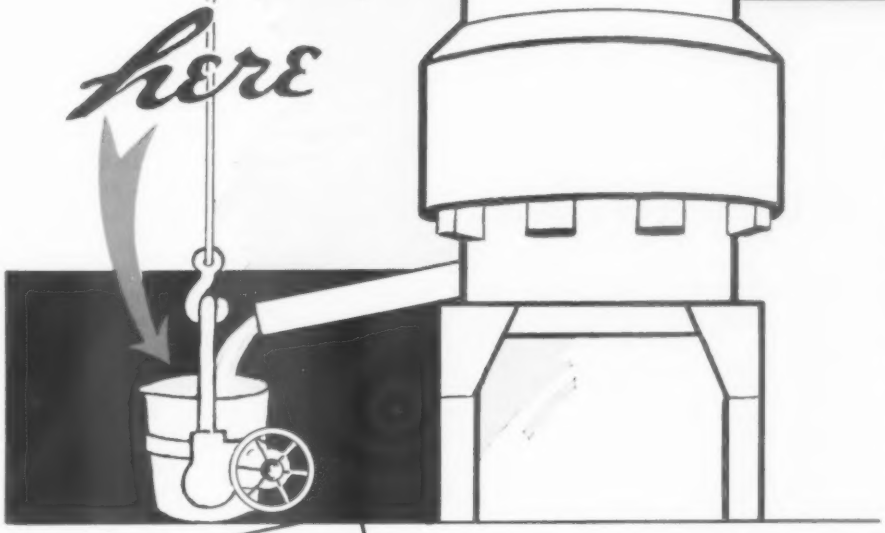
(*Continued on page* 174)



Even the immortal Jules Verne would experience some difficulty in driving a truck in the opposite direction to the traffic

A FEW SECONDS *here*

..*insures* CLEAN METAL *here*



Famous CORNELL CUPOLA FLUX

The condition of molten metal shows up in your castings. Be sure that all impurities are removed and avoid the cause of many rejects, by using Famous Cornell Cupola Flux.

This flux not only cleanses molten iron but makes it hotter and freer flowing, greatly reduces sulphur and keeps slag fluid.

Improved castings are proven in great reduction of chilled sides, hollow centers, hard spots—and easier machining.

Cupolas are cleaner, drops are cleaner, bridging over is practically nil, maintenance is reduced sharply.

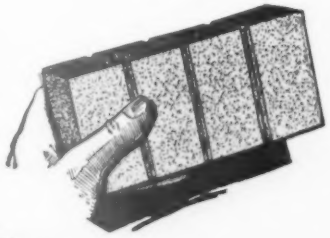
Write for Bulletin No. 46-B

MALLEABLE FOUNDRIES with cupola operation, are rapidly turning to Famous Cornell Flux to give their castings a better start.

EXCLUSIVE SCORED BRICK FORM

Accurately measured for instant use.

You simply lift Famous Cornell Flux out of container and toss it into cupola with each ton charge of iron, or break off one to three briquettes (quarter sections) for smaller charges, as per instructions.



Famous CORNELL ALUMINUM FLUX

CLEANSES MOLTEN ALUMINUM so that you pour clean, tough castings. No spongy or porous spots even when more scrap is used. Thinner yet stronger sections can be poured. Castings take a higher polish. Exclusive Formula greatly reduces obnoxious gases, improves working conditions. Dross contains no metal after this flux is used.

The CLEVELAND FLUX Co.

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Manufacturers of Iron, Semi-Steel, Malleable, Brass, Bronze, Aluminum Flux Since 1918

FAMOUS CORNELL FLUXES
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Famous CORNELL BRASS FLUX

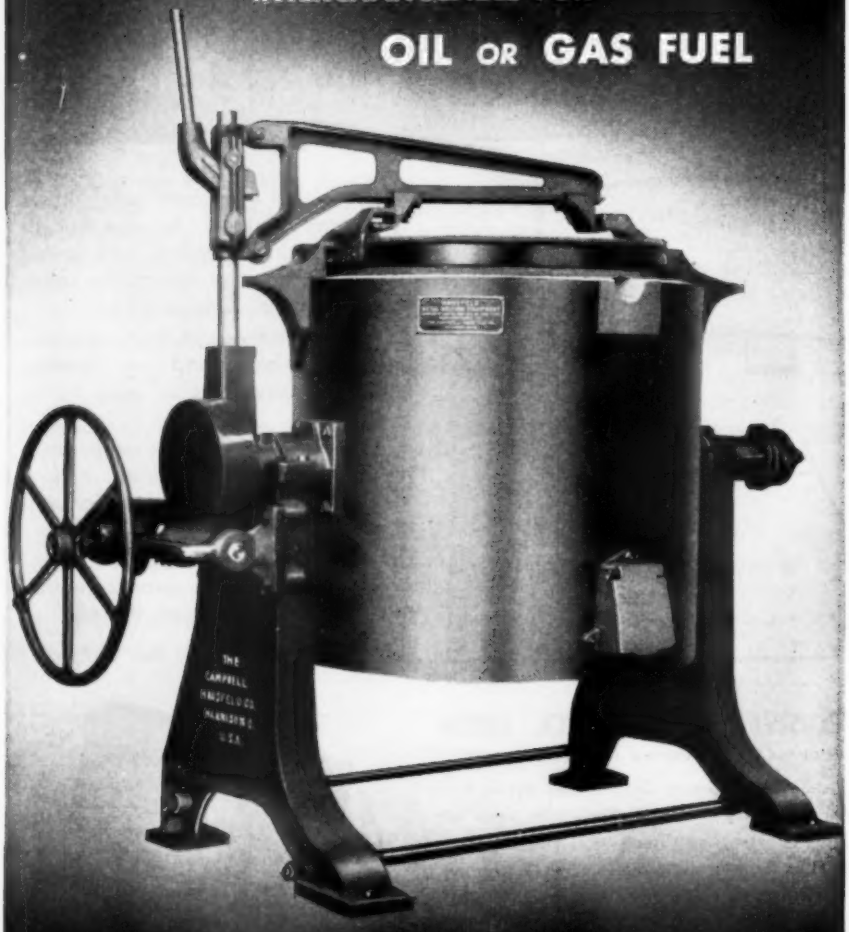
CLEANSES MOLTEN BRASS even when dirtiest brass turnings or sweepings are used. You pour clean, strong castings which withstand high pressure tests and take a beautiful finish. The use of this flux saves you considerable tin and other metals, and keeps crucible and furnace linings cleaner, adds to lining life and reduces maintenance.

HAUSFELD

A FURNACE FOR EVERY NON-FERROUS MELTING REQUIREMENT

INTERCHANGEABLE FOR

OIL OR GAS FUEL



Built for Service

The Campbell-Hausfeld Co.

300-320 MOORE ST. HARRISON, OHIO

(*Continued from page* 172)

planted by Paul Bunyan's grandfather so that the boy, when he came to his full growth and had finished logging off Maine, Michigan and Wisconsin, would have something worth the effort of himself and his famous blue ox Babe. One prominent lumber company out there claims that Paul still is on the job, and on the payroll."

"If I may coin an original phrase, we live and learn. Up to the present I held to the belief that Shangri-La was something dreamed up by a cinema script writer. Several years ago my faith was shaken to some extent when the late president of this great E Pluribus Unum republic, enjoying an outing at Yalta, referred to Shangri-La as a going concern. So far as I remember he was not checked or corrected by Joe or by any of the comrades, bully boys and boon companions on that occasion. Of course, on the other hand, as you might say, in high diplomatic circles, silence does not always mean consent. Just like the usual double talk on the lofty plane, it may mean, yes, no, or any shade of meaning in between.

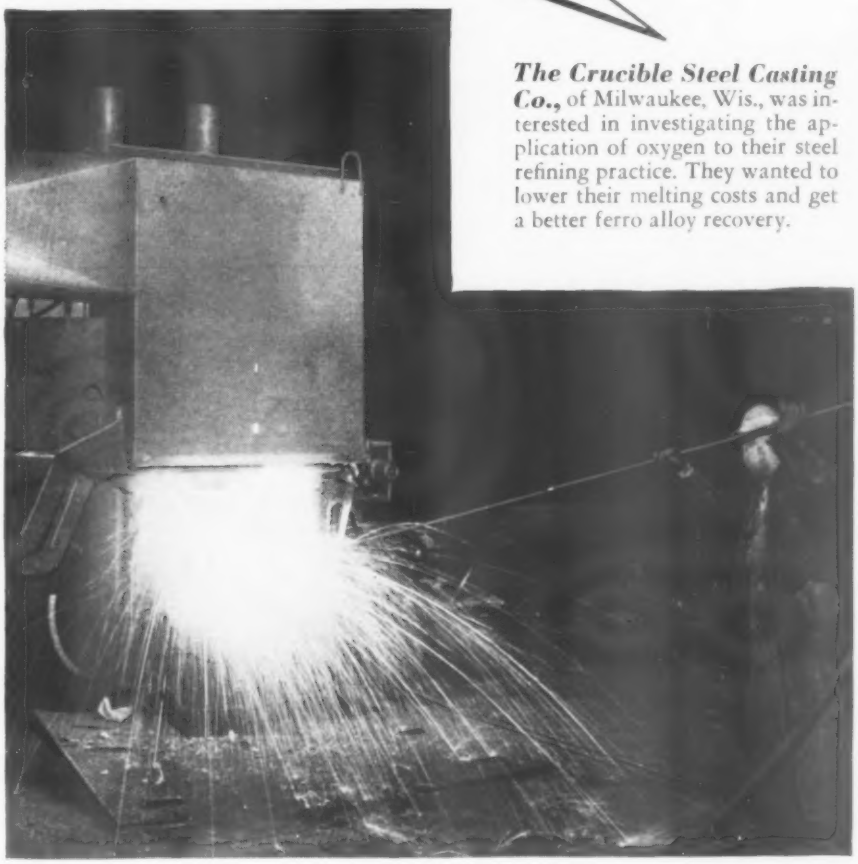
"The name popped up again last fall when the No. 2 boy in the Washington establishment gallantly galloped out West as far as the banks of Ol' Man River, swung a lady off her dainty feet and then galloped away again. In a commendable, thoughtful and truly co-operative spirit the lady had her bag—pardon me—bags, packed and ready for the grand flight. Held up temporarily at the church door after the ceremony, the hero calmly went through the quiz program. Replying to a question from a solid barrier of reporters and camera men regarding his ultimate destination, he informed one and all in a straight-forward, manly voice that the proposed honeymoon would be spent in Shangri-La.

"This priceless and exclusive news item immediately was flashed to every section of the country. Later brief dispatches from points in Kentucky, Tennessee and Georgia seemed to indicate (a) The travelers were making an unnecessary detour. (b) They were lost in an emotional fog. (c) Lifetime habit impelled him to spill a gob of gobbly-gook talk."

"Now that you have drained all the Shangri-La-er-dope-out of your system, where it is and how to get there, it might not be a bad idea to back track as far as Lhasa and find out if, when and how the GE handled the job. Transport of all necessary

(*Continued on page* 176)

Oxygen Refining lowers melting cost . . . permits better ferro alloy recovery . . . improves refractory life



The Crucible Steel Casting Co., of Milwaukee, Wis., was interested in investigating the application of oxygen to their steel refining practice. They wanted to lower their melting costs and get a better ferro alloy recovery.

Clarence Nolan, Airco Technical Sales Supervisor, was called in to demonstrate the use of oxygen in refining acid steel. On his advice, a number of test heats were made in which Airco 99.5% pure oxygen was injected into the molten bath. These tests proved that substantial savings in heat time and power could be realized by adopting this method of refining. When the operation was put in general practice, it was found that in addition to the above savings, it offered better metal analysis control, improved refractory life and further savings through higher recovery of ferro alloys.

Additional savings were also enjoyed when the problem of handling and storing iron ore was eliminated.

For technical assistance or a copy of our folder "Oxygen In The Electric Furnace", please write your nearest Airco office.

AIRCO AIR REDUCTION

Offices in Principal Cities

TECHNICAL SALES SERVICE—ANOTHER AIRCO PLUS-VALUE FOR CUSTOMERS

More news about AIRCO steel mill processes

ACETYLENE SMOKING ELIMINATES HYDROGEN TRACES ON STEEL SURFACE

A leading steel mill, after experimenting on more than 2,000 molds of various sizes, plans to use acetylene ingot mold smoking in all molds that will be used for the pouring of "Tool Steels", "Electric Furnace Steel", "Acid Open Hearth Steel", and "Roll Foundry Steel". They claim that steel poured in molds—*and treated in any other way than by acetylene smoking*, show traces of hydrogen in the surface of the steel.

THE ECONOMICAL WAY TO CUT HEAVY SCRAP TO CHARGING BOX SIZE

Today, Airco offers steel men outstanding oxyacetylene cutting methods for easy and economical handling of heavy scrap. Practically any heavy scrapping job can be handled . . . regardless of size, shape or location . . . with:

- **the oxyacetylene torch, plus oxygen lance.** Buttons, ingots, and similar large chunks can be cut to size in any position without initial handling.
- **machine gas cutting.** Where crane facilities are available, this set-up is ideal. All it requires is a heavy-duty cutting torch mounted on a standard Airco No. 40 Radiagraph or a Travograph.
- **the oxygen lance.** Where extremely large sections, such as open hearth spills and huge ingots are to be cut, the oxygen lance should be used.

All this is just another example of how modern Airco oxyacetylene equipment is helping steel mills slash time and costs.

★ ★ ★

Air Reduction supplies Oxygen, Acetylene and other industrial gases . . . Calcium Carbide . . . and a complete line of gas cutting machines, gas welding apparatus and supplies, plus arc welders, electrodes and accessories. Ask us about anything pertaining to gas welding and cutting, and arc welding . . . we'll be glad to help you.

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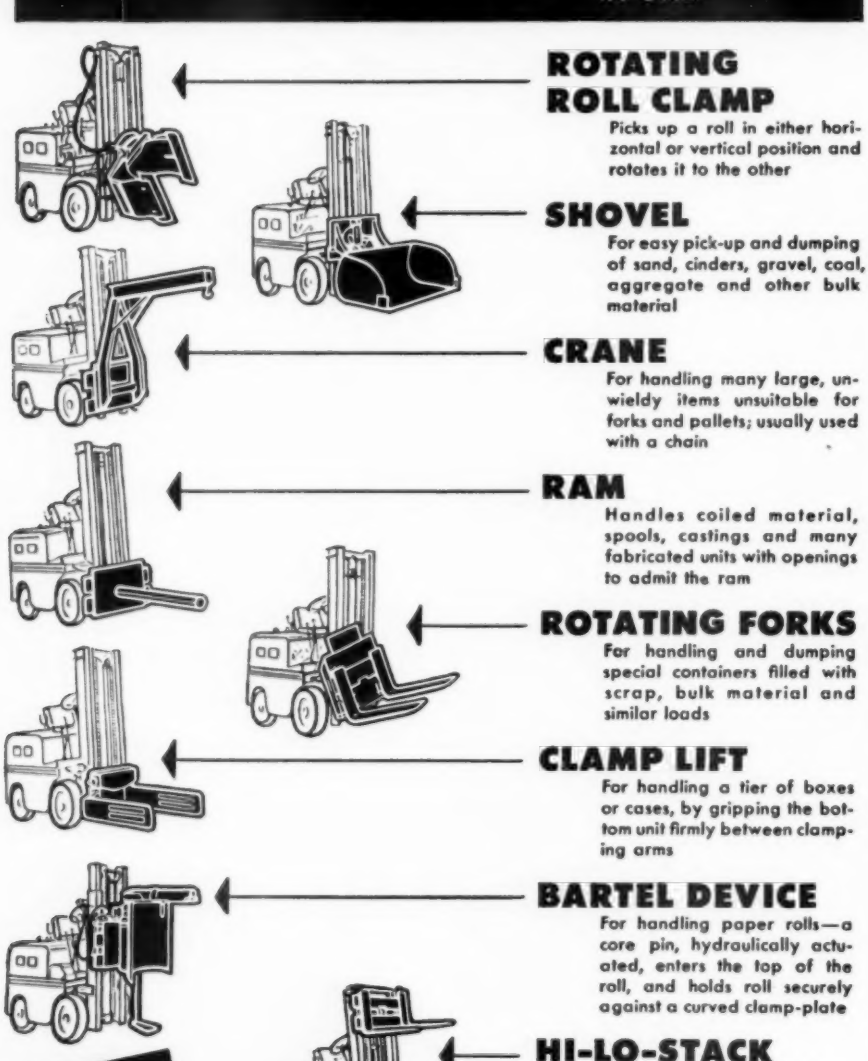

ROTATING ROLL CLAMP
Picks up a roll in either horizontal or vertical position and rotates it to the other

SHOVEL
For easy pick-up and dumping of sand, cinders, gravel, coal, aggregate and other bulk material

CRANE
For handling many large, unwieldy items unsuitable for forks and pallets; usually used with a chain

RAM
Handles coiled material, spools, castings and many fabricated units with openings to admit the ram

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For handling and dumping special containers filled with scrap, bulk material and similar loads

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For handling a tier of boxes or cases, by gripping the bottom unit firmly between clamping arms

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HI-LO-STACK
Free lift of more than 5 feet without increasing overall height; more than average tiering height and low clearance height

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INDUSTRIAL TRUCK DIVISION • **CLARK EQUIPMENT COMPANY** • BATTLE CREEK 16, MICH.

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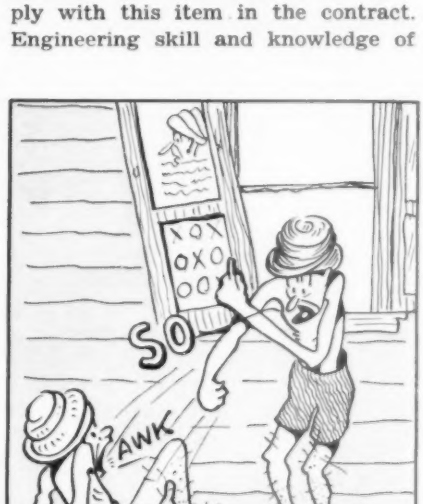
AUTHORIZED CLARK INDUSTRIAL TRUCK PARTS AND SERVICE STATIONS IN STRATEGIC LOCATIONS

(*Continued from page* 174)

material presented considerable difficulty. Lhasa is in the Himalaya range some 400 miles from the rail head. The only available path is exceedingly rough and narrow. The city is on a plateau 12,000 ft above sea level, but to reach it, passes up to 17,000 ft have to be negotiated. For about half the distance mules were employed to carry the loads. Then the loads were changed and carried the remainder of the distance by yaks and porters.

"The customer's order stipulated that no individual case, box or parcel should weigh over 80 lb. In some instances it was impossible to comply with this item in the contract. Engineering skill and knowledge of



Better than choking him with buttah

the highest order, courage, resourcefulness, bribery, profanity, flattery, soul-and-body-terrifying threats were employed freely while transporting the heavier pieces to their destination. The statement has been made—and so far as I know never contradicted—that since the expedition passed that way, not a single blade of grass, or even a vestige of any other kind of vegetation has grown on, or in the vicinity of the trail. The entire shipment was packed in 482 cases. Strung out along the apology of a trail, and allowing a minimum of 10 ft for each mule, yak and porter, it requires no great stretch of the imagination to realize that the long, snaky caravan extended to the best part of a mile.

"So far as the Calcutta office was concerned, the entire expedition disappeared after departure from the rail head, just vanished from sight, sound or hearing among the peaks of the

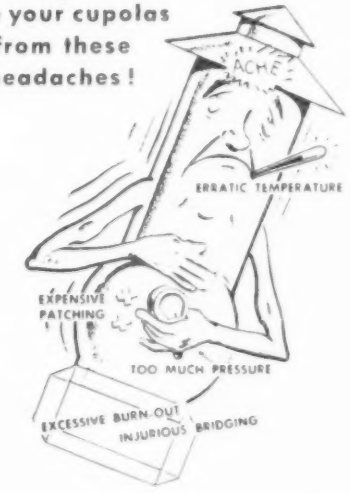
(*Continued on page* 178)

Get Acquainted with

Cupoline

...the *PREVENTIVE* for Many Cupola Ills

Let *Cupoline* free your cupolas from these headaches!



Cupoline leads to slower burn-out, which means a more uniform operation, especially a more uniform melting rate. Variations caused by the human equation are reduced to a new low. Being monolithic, Cupoline eliminates the shortcomings of linings with joints. Its low clay content requires minimum water. This virtue and its high refractory properties avoid the serious hazards of spalling and bridging. In connection with the Bondact process, Cupoline lends itself admirably to contour patching, which saves 25% in material. Linings last much longer if patched with Cupoline; in fact, may be maintained to eliminate reline jobs.

Three types: Cupoline DRY Mix for hand ramming; uniform homogeneous scientifically correct mixture. Cupoline PLASTIC Mix for hand patching cupolas, spouts, ladles, etc.; ready for use — no confusing formulae for mixing. Cupoline BONDACT Mix for air placement; the ideal combination with the Bondactor machine; cupola patching at its best and cheapest.

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If you want better blast cleaning, switch to Certified, the high-quality abrasive. Certified's Samson Shot and Angular Grit are modern abrasives, produced by a special, automatically-controlled hardening process that makes each abrasive particle a homogenous mass. Thus Certified wears slowly, can be used over and over again.

With Certified in your plant, castings are cleaned in a jiffy. Scale, rust and dirt disappear completely, giving you more efficient blast cleaning. Find out for yourself how Certified's higher quality pays off in the cleaning room. Order Certified Abrasives today and get better blast cleaning!

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Accepted and used for over 55 years

PITTSBURGH CRUSHED STEEL CO.
PITTSBURGH, PENNA.

STEEL SHOT AND GRIT CO.
BOSTON, MASS.

(*Continued from page* 176)

Himalayas, loftiest mountain range in the world. Something over a year later a letter from Lhasa arrived at the office. It was written by a young native engineer who had been educated, and had served an apprenticeship in an engineering establishment in England. He now was in charge of the recent installation in Lhasa. In part the letter was as follows:

You will remember the order for Lhasa lighting equipment was held in abeyance pending satisfactory erection and working of the transformers and transmission line supplying power to the factory from Dordi, about 6 miles distant. After a year's continuous working the equipment so far supplied by you has given us every satisfaction so that now we desire to proceed with the scheme for lighting Lhasa.

"Apparently the plan was to work the factories all day then switch over and light Lhasa by night. The order which accompanied the letter was written in the Tibetan language on thin rice paper 24 x 47 in. It was signed by the seal of the directors of the Debchi factory, and was dated '21st of the fourth month of the water bird year.' No member of the office staff writes, reads or speaks Tibetan, but this presented no handicap in filling the order. A typed translation in excellent English, on similar paper and with a similar seal accompanied the original."

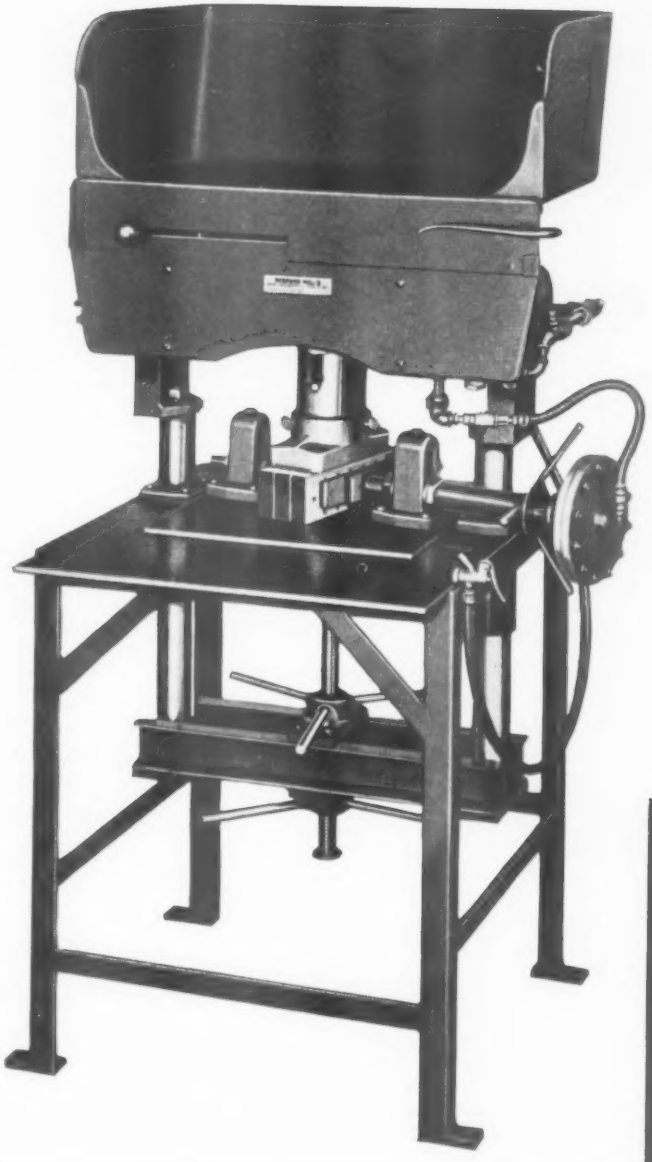
"Your comment about the loads being limited to 80 lb, reminds me of a peculiar inquiry I had some time ago. I don't know about the carrying capacity of a mule, and even less about the weight and size of a load that can be piled on the shaggy back of a yak, but the porters are the lads for my money. Can you imagine any man carrying an 80-lb load up and down mountain sides for 400 miles? This inquiry I had also deals with weight carrying. Here, I'll read it to you.

In a recent survey designed to estimate the weight or volume of castings produced per day per molder, we have been somewhat puzzled by the wide variation in the figures submitted. A workman's efficiency is measured by what he produces. For example, a bricklayer lays so many bricks in a day. A printer sets so many lines of type. Then why cannot a molder's efficiency and rate of compensation be standardized on the weight of castings he produces in any given period?

"Well, it takes all kinds of people to make a world, I always say. Taking up the trusty old pencil I wrote him that basing an opinion

(*Concluded on page* 180)

Redford CORE BLOWERS



REDFORD NO. 2 STATIONARY MAGAZINE TYPE CORE BLOWER . . . . .

New standards are being set with this machine, because every motion of your operator has been correctly evaluated to obtain a maximum of production with a minimum of effort.

8 OUTSTANDING FEATURES:

1. Large stationary work area.
2. Large sand supply hopper.
3. Stationary sand magazine.
4. Easy accurate locating of core boxes.
5. Quick change magazine heads.
6. Quick adjustment for different height core boxes.
7. Quick change, fully adjustable, vertical clamping attachment.
8. Actuating one handle clamps the core box, blows the core and releases the core box, in two seconds.

CAPACITY: Cores up to 5#

Write for Specification Bulletin "F"

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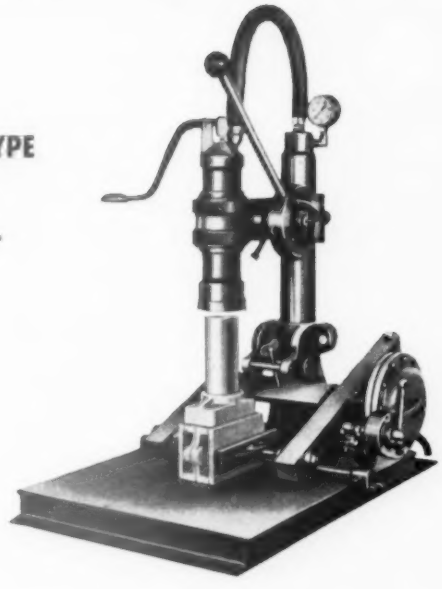

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Thousands in use in American Foundries . .

Write for Specification Bulletin *"G"*

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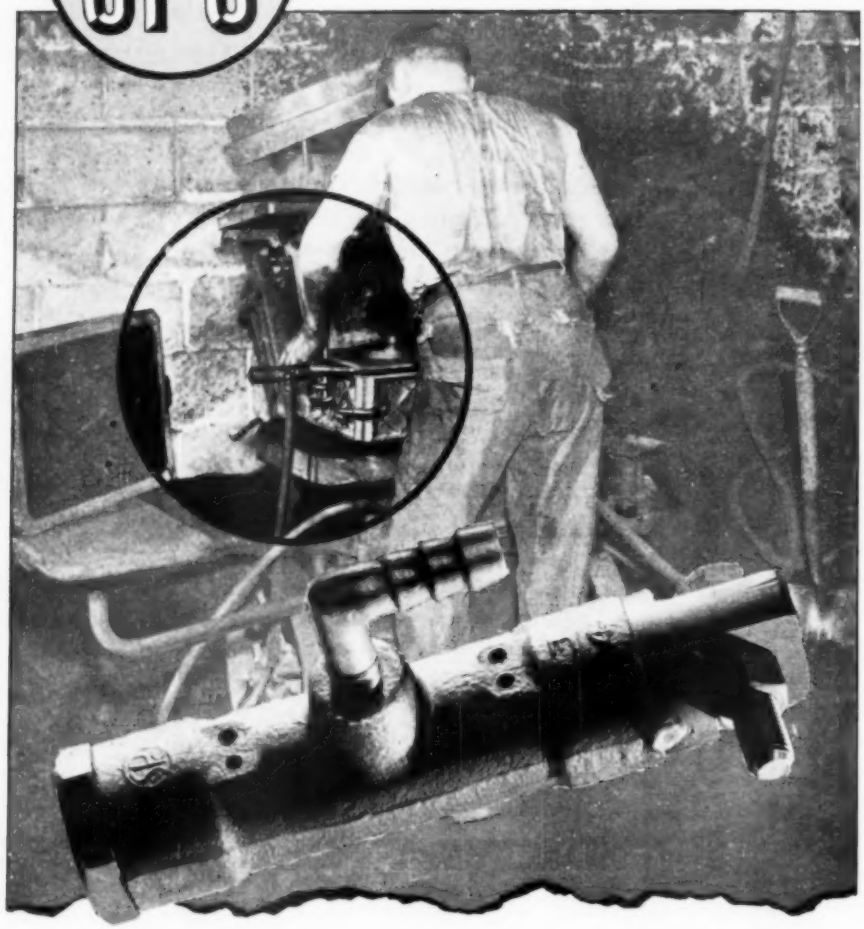

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Powerful Series 76 **SPO** air-vibrators are foundry-engineered for maximum efficiency and low-cost operation. These durable impact-vibrators can be attached quickly and easily to match-plates, sand hoppers, flasks, and other foundry equipment to deliver powerful vibration anytime and everytime it's needed.

Available in 8 sizes, with piston diameters ranging from ½ to 2½ inches, Series 76 vibrators feature a **special bronze alloy cylinder liner** that provides permanent piston lubrication and greater operating efficiency.

SPO vibrators start instantly with full power and deliver from 2200 to 6000 impacts per minute on standard 80 p.s.i. line pressure, depending upon piston diameter. Both piston and cylinder ends are uniformly hardened to resist powerful blows and to assure a longer, trouble-free service life.

SPO offers a complete factory-rebuild service, **at cost,** which is guaranteed to make your **SPO** vibrators good-as-new. Send your **SPO** home for repair . . . and it will perform at peak efficiency for years . . . and years . . . and years.

SPECIFY SPO FOR POWERFUL, DEPENDABLE VIBRATORS

WRITE FOR CATALOG

SPO INCORPORATED

6449 GRAND DIVISION AVENUE • CLEVELAND 5, OHIO

(*Concluded from page* 178)

merely upon the number of pounds of castings produced per man per day may lead to erroneous conclusions. So many other factors must be considered that if you are seeking a comparison of costs, the single item of production per man practically is worthless. The only manner in which comparison can be drawn intelligently is to provide two identical sets of conditions, and two identical men. This is almost out of the question even when comparing foundries in one locality.

"When attempt is made to compare conditions and performance in two widely separated countries, the result of an investigation or survey may be interesting from an academic standpoint, but any information gained in that manner cannot or, perhaps more properly speaking, will not be put to any practical use. Any comparison between the product of a man in a mechanically equipped shop, and a man working in a plant where mechanical equipment is conspicuous by its absence, is like comparing the shooting of a man armed with a high-power rifle, and a man armed with a toy bow and arrow.

"Presence or absence of sand handling equipment, power cranes, conveyors, molding machines, special flasks, a system of payment that induces men to exert themselves to capacity, and other features frequently furnish a more reliable foundation than the number of men employed on which to base certain calculations. A point frequently overlooked is that the mechanical equipment represents a considerable outlay in installation, maintenance, operation and repair, items which must be taken into account in any comparison that pretends to even approximate accuracy. Over the entire country one might venture a guess that about 500 lb represents the average daily production of a molder. The figure may be interesting, but it is of no practical use, where extremes may vary from a few ounces to several tons.

Reaches 50th Year

East St. Louis Works, American Steel Foundries, 2039 East Broadway, East St. Louis, Ill., celebrated its 50th anniversary June 12. Originally incorporated on that date in 1900 as Shickle Harrison & Howard Foundry, the company was consolidated in 1904 with several plants throughout the country to form American Steel Foundries.

31

years ago:

McQuay-Norris

said . . .

No other Piston Ring has Metal like this

To improve on cupola-melted piston ring metal, the McQuay-Norris Manufacturing Company has changed all old established iron foundry practice. They have applied to piston ring manufacture the same method that has revolutionized the making of high-grade alloy steels—the Electric Furnace—the only one used in this country today for melting commercial gray iron. This improvement places McQuay-Norris Rings in still another class by themselves.

Written 31 years ago, that story is just as factual today: The accurate control possible with an electric furnace, the closer grain structure obtained at the higher temperatures, the greater uniformity possible; all result in better castings.

McQuay-Norris now has two Lectromelt Furnaces. That 3-ton furnace bought in 1919 has been modernized with Lectromelt electronic controls and other refinements. The second, installed in 1943, will do almost as much work as the old-timer although it's rated at half the capacity. It is top charged, rather than door charged.

If you're interested in learning what a Moore Rapid Lectromelt Furnace will do for you, write Pittsburgh Lectromelt Furnace Corporation, 314 32nd Street, Pittsburgh 30, Pennsylvania.

Manufactured in . . . CANADA: Lectromelt Furnaces of Canada, Ltd., Toronto 2 . . . ENGLAND: Birlec, Ltd., Birmingham . . . SWEDEN: Birlec Elektkougnar A/B, Stockholm . . . AUSTRALIA: Birlec, Ltd., Sydney . . . FRANCE: Stein et Roubaix, Paris . . . BELGIUM: S. A. Belge Stein et Roubaix, Bressoux-Liege . . . SPAIN: General Electrica Espanola, Bilbao . . . ITALY: Forni Stein, Genoa.

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Converts from bucket to platform without tools.

Eight hours continuous running on 3 gal. of fuel.

Bucket holds 10 cu. ft.

THIS versatile machine is doing a remarkable job in many foundries. It can do the same for you. If some particular problem of material handling is bothering you—the Prime-Mover can answer that one and additionally help in a number of other ways, too. This rugged unit works outdoors and indoors to keep things moving. Here is a labor saver that has cut foundry handling costs as much as $36 a day. Mail coupon. We'll send you complete information at once.

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Gentlemen: Please send detailed information on the Bell Prime-Mover in foundries.

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TIN BRONZE CASTINGS

(*Continued from page* 77)

The time-temperature curve is approximately the same as a temperature-heat curve, except that the latter would show no tendency to flatten at the lower end, but would be much as is indicated by the heavy dotted portion. Horizontal distances on this latter curve would then indicate the amount of heat in calories, or in Btu, which is given out by the metal during solidification and cooling. Using the reverse reasoning, by following the curve from right to left, it shows the amount of heat which must be put into the metal to heat it to the melting point, then through the melting range (represented by *CB* on the curve) until it is completely melted. To the left of *B* the curve represents the amount of heat required to raise the temperature above the melting point. Briefly, the highest portion of the curve represents superheat.

Metal Heats the Chill

Before a large external chill can be melted, or burn into the casting, its surface must be heated from the temperature *D* to a temperature at least slightly to the left of *C*. The only heat available for such heating and melting is that heat in the molten metal poured against it and is given off as it cools from *A* down to a point somewhat to the left of *C*. While this molten metal is trying to give up enough heat to melt the solid metal, the latter will be conducting the heat away from the surface. The larger the chill, the more heat will be conducted away and the less likelihood for the molten metal to give up enough heat to actually raise the temperature of the chill above the point *C*.

The sequence of cooling can be stated approximately as follows:

1. The first molten metal contacting the chill will give up its heat quickly and form a thin solid layer upon the chill. The chill, absorbing this heat, becomes warmer in the process.

2. Further solidification of metal against the chill can take place only by the absorption of additional heat by the chill. This heat must pass through the chilled layer already formed and must be dissipated throughout the chill plus the chilled layer, the former being heated to a still higher temperature.

3. The chilled layer will build up more slowly as it becomes thicker and the temperature differential between the chill and the metal becomes less.

4. When the chill has been heated

to the temperature of the metal soldified around it, all chilling action will have ceased and cooling thereafter will be exactly as though the chill were no longer present.

The probable result of this sequence is that the chill will never become heated to its melting point. Therefore, no actual fusion will occur. Except for one condition, there would be little chance of a heavy metal chill actually alloying with the metal poured against it, unless the thickness of the molten metal was considerably greater than that of the chill, thus giving off sufficient heat to melt the first chilled skin and the chill surface. This latter condition would be possible only if the chill were so thin compared with the metal volume that its ability to absorb heat was less than the amount of heat available to be absorbed; or, in other words, sufficient heat was available from *A* to *C* to heat the chill from *D* past *C* on the curve.

Molecules May Travel

If the chill should be absolutely clean, with no oxides, moisture, oil or other substances on the surface, the molten metal should come to rest in intimate contact with the chill surface. Although the metal would form a thick, solidified layer against the chill, the chill surface itself would be heated quickly to the same temperature at the chilled layer. In such a case of intimate contact between the chill and the chilled layer, it is highly probable there would be an interchange of molecules across the interface, some of the molecules of the chill traveling across the interface and entering the chilled layer, and an equal number of molecules from the chilled layer traveling in the opposite direction.

The result would be interknitting of the two surfaces into a single piece of metal, similar to the manner in which a forge weld is made. Although we might find a distinct line under a high powered microscope, apparently separating the two layers, this line would be more in the nature of a grain boundary. If such a condition occurred, the chill would become an integral part of the casting without any weakness at the interface, yet without any actual fusion having taken place.

Although we are seldom likely to obtain complete attachment of the chill to the casting in the manner just described, we may get sufficient "burning in" to make the chill difficult if impossible to remove except by chipping, grinding or machining. Prevention of such burning in is a simple matter, however, when we consider that the metal must come into intimate contact with the chill

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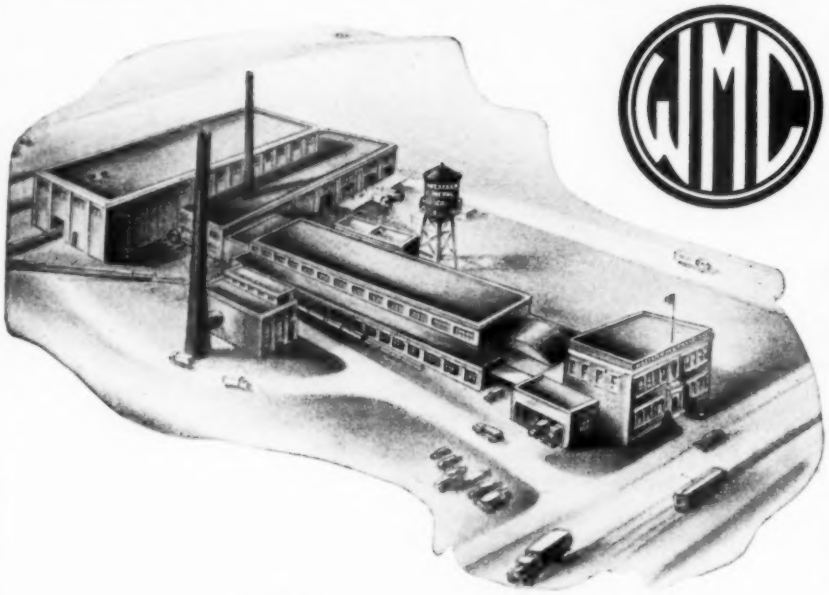

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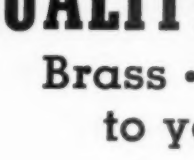

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surface before such burning in can occur. It is only necessary then, to prevent this intimate contact by coating the chill with some substance which will form a continuous film and which will not be dissolved by the molten metal nor react with it.

Almost any nonmetallic substance, painted or sprayed on the chill surface, will prevent the metallic contact which would be necessary to cause the chill to fuse with the casting. There are, however, a number of requirements we must keep in mind to obtain full advantage of the chill, yet introduce nothing which would have a deleterious effect upon the soundness of the casting. Chief among these requirements are:

1. The coating should be capable of producing a thin, continuous film.
2. It must not chip or flake off the chill under the influence of sudden temperature changes.
3. It must not decompose when in contact with the molten metal to form any gaseous compound.
4. It must not react with or dissolve in the molten metal.
5. It should have high heat conductivity.

The ordinary clay wash is usually a heavy, rather viscous suspension of fire clay in water to which a certain amount of molasses, dextrine, or other organic binder has been added. In addition to forming a heavy coating on the chill to prevent, to a considerable extent, the desired passage of heat across the interface, this coating would contain water of hydration and organic matter. Should this water or organic matter decompose at the temperature of the molten metal to form nascent hydrogen, this hydrogen would dissolve in the metal and cause porosity. Baking the coated chills at a high temperature would drive off the water and decompose the organic compounds, but would leave a thick and comparatively weak and friable coating which would be likely to flake off.

It is fairly common practice to coat chills with kerosene or other light oil. Such a coating will turn into gas in contact with the metal. As the chill is impermeable, the gas is likely to be forced into the metal and form gas holes, or even porosity, because of dissolved hydrogen. Burning off the oil before placing the chill in the mold would probably leave a thin fluffy deposit of carbon which, although it would prevent intimate contact between the chill and the metal, would be likely to wash off and contaminate the metal in the mold. There are numerous chill coatings on the market.

It goes without saying that, if the chill is made of material which will

not alloy, unite, or react with the metal, no coating will be necessary. This would be true of steel, gray iron, carbon or graphite chills when used with bronzes.

Care must be taken in using external chills to insure that no moisture from the mold has a chance to collect on them before pouring, otherwise this moisture will be vaporized and enter the casting, causing blowholes or a general overall shrinkage porosity. Condensation can be prevented to a large extent by leaving the molds open until time to pour. This is sometimes rather difficult, especially where a complicated mold takes considerable time to close, also where a number of such molds are closed to be poured from a single ladle of metal. If the chill is heated to a temperature somewhat above that of the sand in the mold, condensation of moisture upon it will be retarded considerably.

Requires Careful Study

Arrangement of chills with respect to the gating, or the arrangement of gating with respect to the chills, must be given careful study. In general, chills should be considered as means of initiating solidification at certain locations which could not otherwise be made to freeze at the correct time, or at the desired rate to permit directional solidification. This being the case, the metal should flow to the chill and come to rest against it. In Fig. 13A, for the metal to travel from the riser to the opposite side of the mold, it must pass over the chill which has been located to initiate solidification in both directions from the mid point of the extensive horizontal section. The chill will cause the metal to freeze prematurely across the whole adjacent section, so that all feeding is cut off at this point and shrinkage will occur beyond. If, however, the casting is gated on both sides, as in Fig. 13B, solidification will be initiated by the chill and will extend progressively in both directions, thus controlling the direction of solidification toward the risers and increasing the likelihood of obtaining a casting free from shrinkage.

An apparent exception to the requirement that metal must not flow past a chill is illustrated by Fig. 14A where a boss is located on the casting and cannot be supplied with a suitable riser. If the heavy section formed by the boss is not fed, it will contain shrinkage. By the judicious use of a chill, calculated to freeze only that portion of the boss which extends beyond the uniform cross section, a uniform section is simulated and can be made sound by methods already discussed. In this case, however, the metal flowing past the chill must not come into contact with it. Intimate contact should occur only when the level of the metal in the mold has risen to the level of the chilled boss.

To obtain maximum advantage from an external chill, we must have contact between it and the metal at all points—the surface of the chill must correspond to the shape of the casting at the point that it is to chill. This may introduce some difficulty when the shape of the casting is other than flat or of circular cross section. Flat chills can be cut from steel plate, and those for chilling fillets can be cut from steel rod of the correct diameter. In other cases, it is almost mandatory that the chill be cast to the contour of the casting. Probably the simplest method of obtaining such contoured chills is to build up the oiled surface of the pattern with plaster of paris or other suitable casting plaster. When this has obtained its original set, it can easily be shaved to the correct size and thickness. This plaster pattern would then be used for

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casting chills of the correct size and shape to be rammed up in the mold.

Before leaving the subject of external chills, we should mention the use of special sands having high heat conductivity. When these are mixed in the usual manner, they are rammed into the mold in those locations where a gentle chilling action is required. In their use, care must be taken to prevent much of these high conductivity sands becoming mixed with the regular sand heaps.

Internal Chills and Chaplets—As the name implies, internal chills are those placed in the actual mold cavity and which become a part of the casting. They should preferably be of the same composition as the metal of the casting, and usually take the form of large headed nails, studs, wire coils, and even large blocks of metal which are arranged to be held in place by anchoring into one wall of the mold cavity. They are intended to serve the same purpose as external chills, that is, to initiate solidification in some heavy section which cannot otherwise be fed satisfactorily. As internal chills become a part of the casting, it is hoped that they will freeze into the casting and form a homogeneously uniform section, free from any discontinuity where the chill is located, or at the interface between the chill and the metal solidified around it. For this reason, the thoughts in their connection are almost exactly opposite to those concerning external chills.

With external chills, we do not want the metal to freeze to the chill, and usually take special steps to prevent it. With internal chills we hope and expect the fusion will be complete. Instead of coating the chill with some material to prevent fusion, we must have it free from any substance which would prevent intimate metallic contact. Such preventive substances would be moisture, oxide films, finger marks—in fact, almost anything which might be placed on the surface by ordinary handling in the foundry, or form thereon even by standing in storage or in the stockroom. It is doubtful if any purchased chill, even when first removed from its container, has a surface sufficiently clean that the molten metal will lie against it and form a zone of fusion throughout the interface.

Surface Does not Fuse

Fig. 12 explains the fusion, or lack of fusion, of internal chills just as well as it does that of external ones. Unless the chill is very small, or the volume of the metal is large or considerably overheated, it is probable that we will have no actual fusion of the chill or the chill surface. If the chill surface is absolutely clean, we will probably have molecular interchange which will have the same effect as though fusion actually occurred. If the chill is not clean, but has an oxide coating, finger marks, or any other substance which can easily be formed by action with the atmosphere, or simply be picked up by careless handling, or has moisture condensed upon it from tne mold, this molecular interchange will be prevented and an unfused chill will result. When we consider that we seldom have a perfectly clean metallic surface, we can conclude that we seldom succeed in obtaining complete fusion between the chill and the surrounding metal.

Were this lack of fusion the only difficulty, we might not be too badly off. Although we would probably have leakage around the chill, we might be able to salvage the casting by drilling out the chill, tapping the hole and screwing in a threaded plug. If the chills have been standing around the foundry, especially in a warm, humid atmosphere, they will tend

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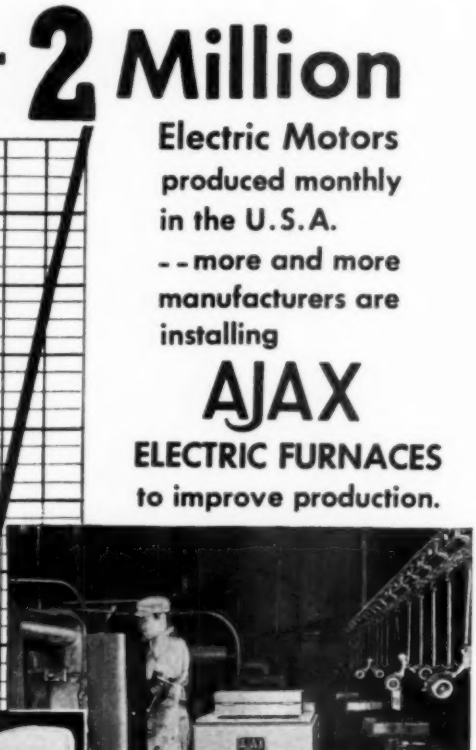

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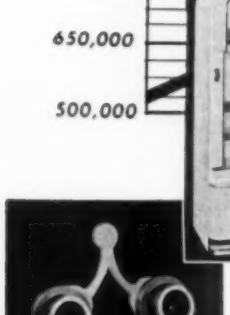

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to corrode, the corrosion products being oxides containing a certain small percentage of combined or occluded water. Moreover, most chills are set in the mold by the molder who, in the course of his work, had his hands in various amounts of core and mold washes, oil and grease, not to mention having them covered with honest yet exceedingly corrosive sweat, all of which will be transferred to the chill surface. When molten metal strikes the chill, these substances will be burned, evaporated, or decomposed, often with explosive violence, forming large volumes of gas, a considerable portion of which will be entrapped in the metal, causing gas holes and porous areas in the immediate vicinity of the chill, and often extending a considerable distance from it.

Chills Source of Danger

It may be argued that, if the chills are small and molten metal can pass by them, we may heat the chills sufficiently to obtain complete fusion. Likewise we may wash away the gas-forming elements into the risers where they would do no harm to the casting. If, however, we flow the metal past the chills, they will fail to serve the purpose for which they were intended. In addition, we would disrupt the carefully calculated mechanism of directional solidification. Finally, it is highly probable that the gaseous products would not be carried out of the mold cavity but would cause porosity in some location considerably removed from the chill but still capable of ruining the casting.

Before leaving the dangers of using internal chills, let us consider another phenomenon which may occur and often does occur, especially when large internal chills are used in the mold cavity. Before pouring starts, the chill is comparatively cold, sometimes very cold in some of our foundries in the winter time. The molten metal surrounding such a chill forms a heavy solid layer which immediately starts contracting as it cools. At the same time, the heat conducted to the chill causes it to heat up rapidly, expanding as it does so. Fig. 15 shows the result of this combination of the expansion of the chill against the contracting metal. The chilled metal layer is ruptured, the resulting crack often extending for distances several times the diameter of the chill. With square or rectangular chills, we may find two or more such cracks radiating into the metal.

All in all, the use of internal chills is a constant source of danger, the discontinuities resulting from their use often causing more trouble from leakage than would the shrinkage which would be present if they were not used. With our present knowledge, the only real recommendation which the author can make is to avoid their use entirely, except under the one condition described below. Certainly he cannot recommend the practice he has seen in one or two foundries where, as an economy measure, large numbers of internal chills were used in lieu of more expensive molten metal.

The one exception to the recommendation to abstain from using internal chills is the case of a high boss which cannot be satisfactorily solidified by an external chill. Fig. 14B shows the use of such an internal chill. The chill actually employed should be somewhat shorter than the one shown, otherwise feeding past the boss area may be cut off by excessive chilling, as illustrated in this case. Size of the chill head should be slightly shorter than the height of the boss and should have a diameter less than that of the hole to be drilled through the casting wall.

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The precaution of having the chill surface absolutely clean is repeated for emphasis. A dirty chill might produce shrinkage or blows which would not be drilled out and would cause leakage. A square, hexagonal or octagonal chill head is also recommended. If the maximum cross-sectional dimension of the chill is less than the diameter of the hole to be drilled, it will not matter if the chill does not fuse in as it will be removed entirely by drilling. However, if a round chill is used and it does not fuse, the machinist might have considerable difficulty drilling out the rotating chill.

Chaplets—Everything said about internal chills applies also to chaplets, the only difference being that, though we can do without internal chills in nearly all cases, we cannot always get along without chaplets. It is true that, by correct design, the necessity for chaplets is sometimes eliminated. In other cases, such as where long slim cores are required, chaplets are necessary to hold the cores in place. The only advice which can be offered is to be as sparing as possible in their use, keep them as small as possible, and have them absolutely clean.

Such cleanliness may require an acid dip to remove all traces of oxide and other dirt; followed by careful washing and drying; then using clean cotton gloves when placing them in the mold. The latter may seem like unnecessary precautions, but if it results in a sound casting, it is certainly more economical than subsequent scrapping or repairing. In this connection, the author cannot recall ever having seen a chaplet used in a bronze casting which did not leak under pressure, unless it had been cleaned thoroughly before being placed in the mold.

We must not forget that every chaplet is really an internal chill, even though not used for that purpose, and that due consideration must be given to this chilling effect, which might be a distinct liability in successful feeding.

Antichills—As the name implies, an antichill would act in a method counter to that of a chill. It would be made from material having low heat conductivity and perhaps low heat capacity and would have the effect of retarding the rate of soldification. In many castings will be found sections which can best be fed through a somewhat thinner section, yet it is not practicable to use a chill on the heavy section. One such section is illustrated in the casting shown in Figs. 8 to 11 of the paper "Insulating Pads and Riser Sleeves for Bronze Castings" by Taylor and Wick (THE FOUNDRY, October, November, 1945).

Fig. 16 indicates a possible use for such an antichill. Ordinarily this casting would be made with straight, uniform side sections, using top pouring and a chill as shown to initiate freezing at the bottom. Straight sides would necessitate machining out the circumferential groove, thereby removing the chilled skin and increasing the liability to leakage at this point. If the groove were molded in regular molding sand, then the casting wall would freeze across at the narrow point and destroy feeding to the area below. This lower part might be chilled but the chilling would have to extend at least up to the bottom of the groove. The use of such chilling would disrupt feeding to the bottom of the casting and considerable shrinkage throughout the lower part would result.

If we make a core ring of suitable refractory insulating material and place it in the mold, as shown, to form the groove, solidification will be retarded sufficiently to permit feeding past this narrow spot into

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the lower part of the mold cavity. If this "antichill" is proportioned correctly, it should exactly counterbalance the effect of the reduced section, allowing this reduced section to freeze exactly as if the narrow portion did not exist.

Conclusion—The preceding discussion has been offered to indicate that, by giving careful consideration to casting design and to the correct arrangement of sections in the casting so that every part of the casting can feed that part immediately below it; by using tapered sections where necessary to promote directional freezing from remote parts of the mold toward the risers by using chills to initiate freezing where necessary, and antichills where it is necessary to retard solidification; then using scientifically designed risers; and finally by providing gating to conduct the metal into the mold cavity in the correct relation to all other parts of the mold; only by such application of scientific principles can we expect to obtain correct directional solidification throughout the casting.

Without such a carefully planned and applied system of control of the many variables existing in nearly every design, we can hardly expect to obtain any casting having the necessary soundness. Perhaps the most important statement which could made in this connection would be: *Never take a chance on how metal will solidify, for you will certainly lose!*

Reference

7. W. J. Richmond, THE FOUNDRY, Vol. 75, No. 10, October, 1947, p. 72.

Business Forms To Be Surveyed

Gray Iron Founders' Society, 210 National City-East Sixth Bldg., Cleveland 14, is surveying printed business forms used by foundries throughout the industry. Member companies in the United States are invited to send to the society specimen samples of forms they use in conducting their business.

The society will gather all forms which serve the same purpose into separate brochures. Any member desiring to develop a new form, or revise one in use, may request loan of one of the bochures for the purpose of obtaining ideas or for selecting a form which will fill its requirements.

Some of the forms covered by the survey are: Material requisitions, orders, cupola reports, costs, job tickets, estimating, medical reports, inventory control, employee records, production scheduling, shipping orders, inspection reports, etc.

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Textile Machinery

(*Continued from page* 81)

at the junction of cylinder and internal flange is sprayed with a proprietary binder mixed with graphite.

In the coreroom the core blowing machines are on one side; at a long row of benches on the opposite side small and large cores in almost infinite variety are made. Cores are dried in two batteries of oil-fired ovens in the center of the room. Core racks are suspended from part of the universal monorail system. Racks remain close to the coremaking stations until they are loaded, then, still suspended, they are moved along and placed in designated ovens. After the cores are dried the racks are moved close to an extensive storage rack or magazine with each space properly numbered. The cores are unloaded into these pockets and the core racks are returned to the various coremaking stations.

While the entire foundry is maintained in a clean and orderly manner, the coreroom is worthy of special mention. In the manner of a caretaker of a hotel lobby, pushing a dust pan and mop, a veteran employee patrols the shining hardwood floor and collects any small driblets and sand that fall from the benches. All the sand used in the coremaking department is clean, new sand. No attempt has been made to retrieve used or burned cores or to incorporate this sand in any of the core mixtures.

To meet the exceedingly close tolerances in the casting known as a winder gear box, it has been found advisable to make the mold in an oil sand core assembly. The principal features are illustrated at lower left on page 79. Two views of the rough castings are shown mounted on the center table. The term rough is merely a foundry euphemism and simply means the casting as removed from the mold. The core which forms the interior of the casting is shown in the foreground, right and left. Part of the assembly, interior core mounted on the base core, also the micrometer gage and the 5/32-in. thickness gages are shown at the left. An assembled mold, base, side members, cover core and method of clamping are shown at the right. The sprue and the opening of a small popoff riser are on top of the cover core. A row of these molds, 12 or more, is set up a short distance from the front of the cupolas.

Cupolas Slagged in Front

There are five cupolas located at one end of the foundry. Three of these, lined at present to 48 in., are used to melt the daily heats. While the heat is being melted in one, the other two are being repaired. The cupolas are equipped for pouring a continuous stream into a stationary reception and mixing ladle and for front slagging. A dam in the spout maintains the metal at a height of 4 in. above the tap hole. The metal flows under the dam and into the ladle. The slag, which floats on top, flows off through an opening in the side of the spout and into a container. In addition to the limestone, a proprietary flux is added to the charge. For certain castings, particularly those of extra thin section, powdered ferrosilicon is added to the metal in the ladle to prevent chill.

On the spacious charging floor two magnet cranes make up the charges in buckets, while a third crane drops the charges into the cupola. After charging the empty buckets are placed on one end of a U-shaped

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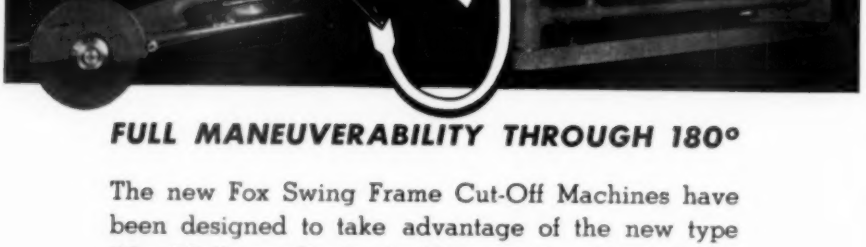

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roller conveyor extending over a 5-ton scale under the magnet cranes which weigh up the pig iron and scrap. Then the bucket is pushed on to the other leg of the conveyor where the coke and limestone are added. The bucket is now picked up by the charging crane, the charge dropped into the cupola and the empty bucket placed once more at the tail of the procession to travel in regular rotation through the cycle. Coke and limestone are weighed accurately in wheelbarrows which pass over a platform scale set flush with the floor and are then dumped into the bucket containing the iron charge.

Supplies Stored in Bins

Pig iron and scrap are brought from the foundry yard in a train of open-top cars pulled by a narrow-gage diesel-electric locomotive. Coke, limestone, refractories and core sands are delivered to the charging floor by diesel-electric locomotive on standard-gage track and stored in open side bins. The sand is taken into the core room as required. Under average conditions the weekly core sand required is 85 tons. Core sand mixtures are prepared in a muller type mixer and distributed by truck or wheelbarrow, depending on the location and amount required.

Molding sands are received on the main foundry level by truck or by standard-gage freight car where they are stored in large bins and distributed throughout the foundry by gasoline and electric trucks to the desired locations.

The cleaning room is equipped with a battery of tumbling barrels, airless blast units, grinding wheels and chipping benches. The long rail castings and other large castings are loaded on the revolving table of an extra large airless blast machine to remove sand from the surface. After rigid visual inspection, the castings leave the cleaning room and are transported either directly to the various machine and erection shops, or placed in an extensive storage department, from which they are drawn as required by the other departments. Bins, racks and shelves in the storage department are lettered and numbered for easy identification. This is for the benefit and guidance of comparative newcomers, 5 and 10 year men. According to popular belief, the old boys, the genuine veterans, could go into the racks in the dark and pick out any needed part or parts!

Patterns and other small castings are made in a tidy little nonferrous foundry adjoining the main foundry near one end. It is equipped with four oil-fired crucible furnaces which

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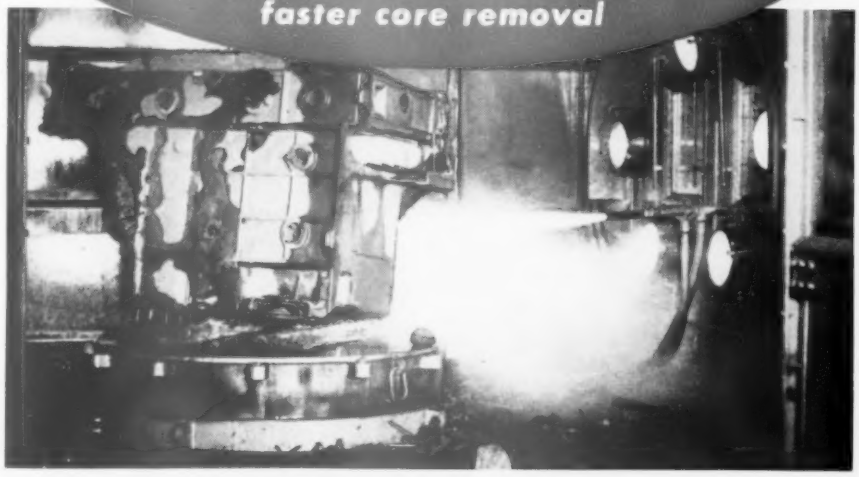

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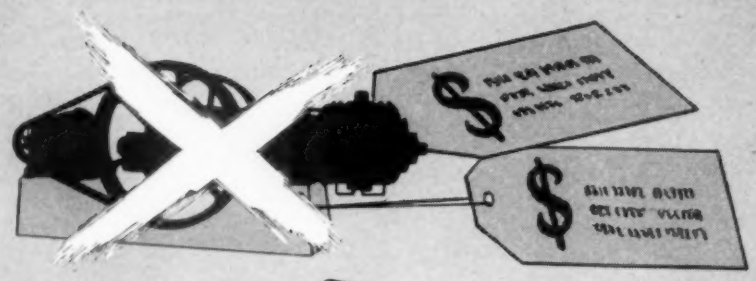

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accommodate No. 40 pots. According to ordinary nomenclature, that means a holding capacity of 120 lb brass or bronze, or 50 lb aluminum. While melting, each furnace is covered by a sheet steel cylinder which connects the furnaces with an exhaust system for removal of obnoxious fumes from the work area. A quadrant shown at lower right page 81 enables one man to lift the loaded crucible out of the furnace.

NICKEL ALLOYED BRASS AND BRONZE

(*Continued from page* 89)

products where small percentages of nickel are used is not appreciably different from the practice that would be employed for the same unalloyed base metal compositions. The basic principles governing the mixing, melting, fluxing and pouring practices for these alloys are amply dealt with in publications such as *Non-Ferrous Melting Practice*[6] and *Process Control of Brass and Bronze Foundry Procedure*[7]. Recommended practices for molding and gating the complex nonferrous alloys have been published[8] and are currently reviewed and studied by committees of the American Foundrymen's Society.

The current practice of melting nonferrous alloys, consisting of rapid melting with a slightly oxidizing flame; treating the metal with an oxide addition; deoxidizing and desulphurizing with appropriate finishing additions, and pouring at proper temperatures into molds made of materials with suitable permeability, refractoriness and surface finish, does not differ appreciably for the nickel alloyed products as compared to the unalloyed ones. To produce a nickel alloyed composition merely requires the presence of a proper amount of nickel. Therefore, its introduction may occur by way of nickel alloyed ingot of the desired composition or by means of copper-nickel alloys, or by means of special foundry products containing nickel which, in certain cases, may exercise the dual function of alloying and deoxidizing or processing the melt.

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7. Special publication (Sp-52), Society of Automotive Engineers.
8. *Recommended Practice for the Sand Casting of Non Ferrous Alloys*, American Foundrymen's Society, 1944.

Sources of Illustrations

Illustration at top left of page 86 and Fig. 7—Cleveland Worm & Gear Co., Cleveland.
Fig. 8—Baush Machine Tool Co., Springfield, Mass.
Fig. 9—Lakeside Bronze Co., Buffalo.

New IFMA President Takes Office

At its annual meeting May 15 at Hot Springs, Va., the Industrial Furnace Manufacturers Association elected Henry M. Heyn, sales manager, Heat Treat Division, Surface Combustion Corp., Toledo, O., president for the current year. In accepting

HENRY M. HEYN

the office, Mr. Heyn stressed the responsibilities of the IFMA and its members to the nation in terms of their contribution to military preparedness and security.

In considering the current economic position of the furnace industry, Mr. Heyn pointed out the need for continuous research and development to provide better furnaces for the industry's customers. He pointed out that the most effective means of selling production equipment, such as industrial furnaces, was through improving this equipment to such an extent that the customers' current equipment is economically obsolete and he has little choice but to buy the new equipment, on the basis of sound economics.

Catalytic Combustion Corp., 4544 Grand River Ave., Detroit 8, recently was formed to design and manufacture catalytic elements for use in fume incinerators and other air pollution control devices. R. J. Ruff is president, H. R. Suter, vice president, and N. C. Ruff, secretary-treasurer.

Give this Sound Thought

DON'T BE MISGUIDED by lower PRICE.

The old saying—"you get only what you pay for"—is a fact when buying metal abrasives.

It is true, cheaper abrasives require a smaller initial investment, but you buy in larger quantities with proportionate freight and freight handling cost.

THE YARDSTICK OF REAL ECONOMY in blast cleaning and peening abrasives is the quality and length of service.

20th Century Quality Pays Off

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The Outstanding MALLEABLE Shot and Grit

So good, that we invite comparison with other makes of malleable abrasive.

It is stress relieved, and there is practically no shattering. Amazingly uniform, too.

It reduces equipment wear 50% to 75%.

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20th CENTURY DRAWN STEEL SHOT

For PEENING and BLAST CLEANING

This cut wire shot is the newest development for better peening and cleaning, and greatest durability. Better, because the pellet size and mass remain uniform many passes longer.

Reduces equipment wear and maintenance is reduced amazingly.

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The CLEVELAND Metal Abrasive Co.

Main Office and Plant: 887 East 67th Street, Cleveland 8, Ohio
Howell Works—Howell, Michigan

New EQUIPMENT and Supplies

For Additional Information on these Items Use Reply Card—Page 197

(1)—Sand Testing: Harry W. Dietert Co., 9330 Roselawn Ave., Detroit 4—New ramming device rams sand test specimen to a specific hardness by applying a selected squeezing load to the sand sample contained in the test mold. A green hardness tester forms an integral part of the ramming plunger, indicating the hardness to which a sand under test is being rammed. The same degree of hardness of rammed molding or core sand attained in the foundry may be duplicated by this unit in the laboratory for testing purposes. Consequently the sand is tested at the same green hardness as it is used in the foundry. With this more practical test data, green hardness of molds and cores may be controlled to standardized hardness values, assuring greater uniformity and higher quality castings, it is claimed.

For More Details Circle No. 1—Page 197

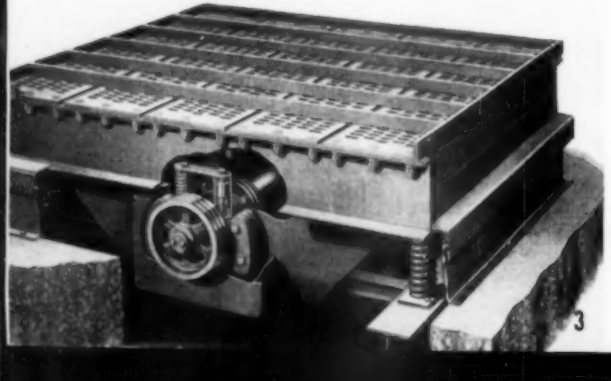
(2)—Chaplets: Fanner Mfg. Co., Brookside Park, Cleveland 1—Newly designed chaplets developed by Battelle Memorial Institute, Columbus, O., are said to promote more perfect fusion between chaplets and casting. Design features include countersunk shoulders intended to permit metal to flow naturally against the entire contour, eliminating voids. Fusion rings are designed with feather edge to heat to fusion temperature quickly and to burn in, eliminating leakers. New type radius grooves are said to permit metal to lay up solidly against the rounded bases of the grooves without trapping gas. Manufactured to tolerances of plus or minus 0.002-in. for most sizes and 0.005-in. on the larger sizes, the chaplets may be coated with pure tin or copper for protection against contamination.

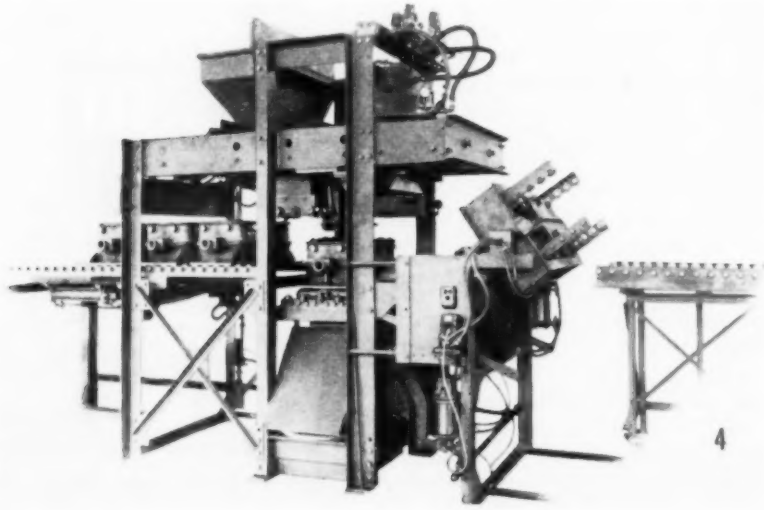
For More Details Circle No. 2—Page 197

(3)—Shakeout: Link-Belt Co., 307 North Michigan Ave., Chicago 1—New shakeouts have completely enclosed full floating vibrating mechanism with automatic, centrifugally operated unbalanced weights designed to limit motion during acceleration and deceleration and eliminate critical speed range hazards. Amplitude of vibration can be controlled by varying the number of segmental weights in the weight assembly. Ready accessibility to operating parts facilitates inspection, lubrication, and servicing. Vibrating deck is accessible from all four sides and has no projecting parts to catch on clothing or be damaged by heavy flasks or castings. Decks on nondischarging types are set horizontally. On discharging types, they are sloped toward the discharge end.

For More Details Circle No. 3—Page 197

(4)—Molding Machine: SPO Inc., 6449 Grand Division Ave., Cleveland 15—Fully automatic machine is designed to produce up to 300 half-

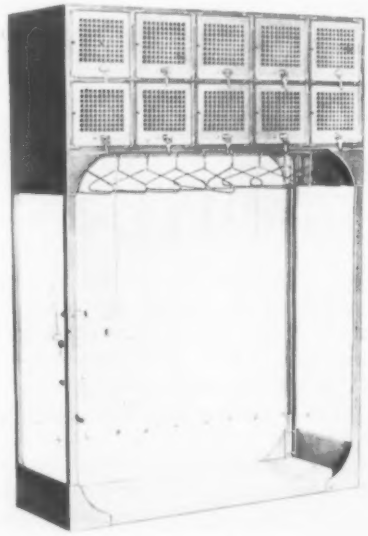




molds per hour. Unit operates on standard 80 psi air pressure and is controlled by solenoid valves through a three-button panel. In production, empty flasks are fed to the machine by standard conveyor. An overhead metering box assembly is filled from the machine's sand hopper, then pulls an empty flask onto a strip frame positioned over the pattern. Flask is lowered by strip frame to the pattern, then charged by metering box. Filled flask is given a predetermined jolt. As metering box assembly returns for refilling and to pick up another flask, the jolted flask is squeezed. The stripping operation begins as the squeeze head retracts. Upon completion of the strip, metering box assembly moves into position with another flask and pushes flask containing completed half-mold toward rollover mechanism. An air blast cleans the pattern as empty flask is being pulled into position. While second flask is being filled and jolted, the first flask is rolled over and carried out of the machine on rollers to a conveyor, completing the cycle. The Series 2000 machine illustrated here will accommodate 14 x 26-in. flasks for drag molds. It has an 8-in. draw. Machines also can be furnished for cope production without the rollover mechanism. Finished cope molds are conveyed out of the machine on a straight carry-off. Other models handle flasks ranging from 12 x 18 to 36 x 48 in.

For More Details Circle No. 4—Page 197

Locker Rack: Lyon Metal Products Inc., P.O. Box 671, Aurora, Ill.—Portable locker rack is designed to accommodate ten persons in minimum floor area. Units are 50 in. wide, 18 in. deep, and 76 in. high. Locker doors measure 8⅞ x 8⅝-in. and are equipped with built-in lock with two keys. Doors are hinged at top so that they drop shut. A chain drops through coat sleeve and is locked with the door, securing the coat. Doors are finished in light tan; balance of unit is green baked-on enamel.



For More Details Circle No. 5—Page 197

Lubricant: Warren Refining & Chemical Co., 750 Prospect Ave., Cleveland 15—New all-purpose lubricant has no melting point, and is said to possess good adhesive qualities, good pumpability at low temperatures and not to break down during working. These features are claimed to give the lubricant long service life and economy in use.

For More Details Circle No. 6—Page 197

Bench Blast Cabinet: W. W. Sly Mfg. Co., 4753 Train Ave., Cleveland 2—Portable bench blast cleaning machine with a base measuring 14 x 18 in. is designed for abrasive blast cleaning of small parts. It operates on compressed air supplied by

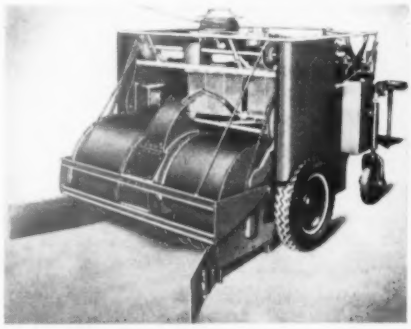
a standard 5 hp, 2-stage garage compressor. Operator loads parts through the top hinged cover and observes the work through the window in the cover. With his hands in rubber gloves the operator rotates the work in the blast stream. A ventilating fan draws off the dust which is retained in a removable filter bag.

For More Details Circle No. 7—Page 197

Heater: Drying Systems Inc., 1800 Foster Ave., Chicago 40—Automatic-controlled, gas-fired heater is suitable for installations requiring temperatures from 100 to 1600° F and where the diluted products of combustion are not detrimental to the process. Usable for core and mold baking, this air heater employs the principle of convected heat. Two sizes with a wide range of capacities offer outputs per hour of 100,000 to 350,000 Btu and 350,000 to 1 million Btu.

For More Details Circle No. 8—Page 197

Sand Conditioner: American Wheelabrator & Equipment Corp., 505 South Byrkit St., Mishawaka 2, Ind.—Sand conditioning machine performs cutting, magnetic separation, screening and piling of foundry molding sand. It is designed to blend new and old sand and water uniformly. The cutting cylinder is said to impart a



mulling action, leaving the sand fluffy, aerated, and cool with good flowability. In addition to removing shot and tramp metal by magnetic separation, the machine screens all other foreign material from the heap, and piles the sand at the molder's benches. Reversible scrapers eliminate need of manual trimming. Unit employs hydraulic steering and is maneuvered easily. It can be supplied in either gasoline or electric drive with variable speeds of from 4 to 25 fpm for cutting and screening, and 25 to 100 fpm when piling or traveling either on the gangway or from floor to floor.

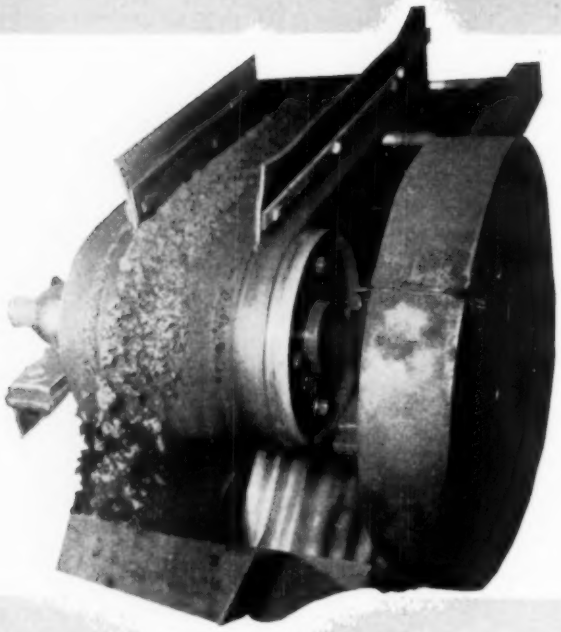
For More Details Circle No. 9—Page 197

Slide Rule: Pickett & Eckel Inc., Five South Wabash Ave., Chicago 3—New pocket-size 5-in. log log all-metal slide rule, bearing the identical scales of its larger 10-in. counterpart, has 22 scales: Front—LL1*, A, B, T, ST, S, C, D, DI, and K. Back—LL2*, DF-CF to pi, CIF, L, CI, C, D, and LL3* (*reciprocal log log scales are back-to-back). Dimensionally stable all-metal body, with optical tongues and grooves machined to 0.001-in. accuracy, insures permanent alignment, freedom from distortion, and easy operation, it is claimed. Telescopic adjustment screws make realignment easy. Slide rule comes in leather pocket case and an instruction manual is provided

For More Details Circle No. 10—Page 197

Adjustable Platform: Revolvator Co., 2008 86th St., North Bergen, N. J.—Adjustable loading platform is designed to level a platform or dock with the height of an automobile truck. Built into the loading platform like a hydraulic elevator, the movable platform is usually about

MAGNETIC PULLEYS?



Dings Non-Electric Perma-Pulley Answers today's Requirements

It's the Modern Way to Remove Iron from Foundry Sand... to Handle Separation of Ferrous and Nonferrous Scrap...

It's...

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FOR new installations or replacement of old, the Perma-Pulley is magnetic separation at LOWER COST. No operating expense... no maintenance ...no electrical accessories... its great power is CERTIFIED... its magnetic permanence is GUARANTEED—just install it and forget it. The Perma-Pulley carries *every* assurance of maximum iron removal.

Learn the facts on why Dings Perma-Pulley is the economical answer to the vast majority of foundry problems. SEND for BULLETIN C-1007A.

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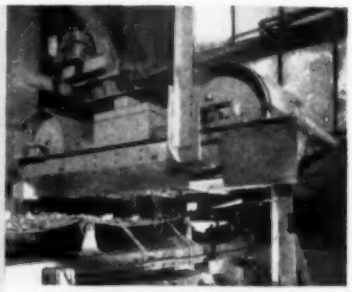
4708 West Electric Ave., Milwaukee 14, Wis.



For extra heavy burden depths, for heavier belt loads at higher speeds, FOR MAGNETIC SEPARATION WHERE OTHERS FAIL, it's the Dings Self-Cleaning Rectangular Magnet. None more powerful.

The Dings Non-Electric Perma-Plate magnet is the most inexpensive answer to many magnetic separation requirements. It's the lightest, most powerful non-electric magnetic separator available.

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All Types of Electric and Non-Electric Magnetic Separators for Every Purpose

18 ft long and 6 ft wide. The inside end of platform is held in position by a pivot, while the outer end is raised or lowered by hydraulic ram operated by electric-oil, air-oil, water, or by hand. Platforms are made to suit requirements up to 20,000 lb.

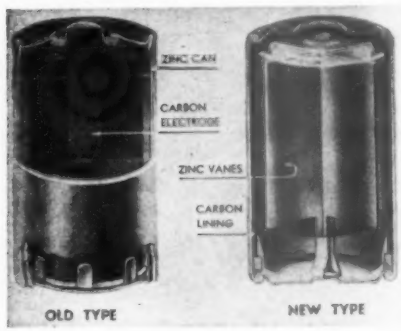
For More Details Circle No. 11—Page 197

Mixer: Multiplex Machinery Corp., Elmore, O.—Portable multiblade mixer with skip loader is de-

signed for mixing refractory materials. Mixing unit is mounted on a truck with four pneumatic-tired wheels so that it can be rolled into the position desired. It also is equipped with lifting hook for conveyance by overhead crane. Unit is complete with skip loader and the mixer is arranged on the carrier so that standard wheelbarrows can be located at the opposite side for receiving the mixed material in any portion desired. Mixer is available in capacities of 3, 5, 7 and 12 cu ft.

For More Details Circle No. 12—Page 197

Flashlight Battery: National Carbon Division, Union Carbide and Carbon Corp., 30 East 42nd St., New



York 17—New construction is used in the company's industrial battery. The container, formerly made of zinc, now is made of carbon, with a zinc power vane as the center element, as shown in the cut-away view. The old type construction consisted of a zinc can container and a carbon rod center electrode. Unlike the zinc container

(*Continued on page* 200)

HELPFUL LITERATURE

50. Masonry Saw

Eveready Briksaw Co.—4-page illustrated circular "Briksaw" describes masonry saw which cuts both wet and dry and has blade pressure equalizer spring to adjust blade cutting pressure automatically.

51. Mold Facing

Hercules Powder Co.—4-page leaflet "Hercules NVX" contains information on NVX water-miscible neutral resin for use in green sand facing. Material helps assure sand of good flowability, uniform ramming and reduction of number of jolts.

52. Safety Equipment

Mine Safety Appliances Co. — 4-page illustrated bulletin CS-26 describes personal protection equipment for shot and sand blasters. Featured are air line type respirators with protective hoods. Details of air supply accessories are given.

53. Hopper Car Unloader

Barber-Greene Co.—4-page illustrated bulletin 448421 describes model 358 hopper car unloader which handles all types of bulk materials at speeds up to 3 tons per minute. It operates in pit or above rails, can be run by one man and has 25-mile per hour road speed.

54. Hoists

Coffing Hoist Co.—14-page illustrated bulletin C-30 is descriptive of Safety Pull ratchet lever, Quik-Lift electric, all purpose Hoist-All, spur gear and differential chain hoists; Mighty Midget pullers; Safety load binders; I-beam trolleys; utility maintenance tools and other lifting and pulling equipment.

55. Foundry Equipment

Smith & Richardson Mfg. Co.—24-page illustrated catalog 148 and price list give full data on line of foundry equipment and supplies which includes chaplets, hinge tubes, tin forms, skim gates and related items.

56. Precision Instruments

Illinois Testing Laboratories, Inc.—4-page illustrated bulletin No. 2982 presents Alnor line of precision instruments which includes pyrometers, electrical resistance thermometers, temperature controllers, Velometers and dew point indicators.

57. Flask Bushings & Pins

Universal Engineering Co.—8-page illustrated catalog F1016 and attached price list cover precision machined, hardened and ground flask pins and bushings for use in cast iron, steel or aluminum flasks. Having stability and accuracy to provide register of cope and drag for hundreds of castings, units are available in several sizes of round, elongated, press fit and other standard types.

58. Graphite Products

Acheson Colloids Corp.—Illustrated 4 and 6 page bulletins Nos. 423, 426, 424 and 425 plus reprint of technical article deal with available types of "dag" colloidal graphite and applications as high temperature lubricant, for metalworking operations, for industrial lubricants, in foundries and as treatment for mold surfaces.

59. Hooks, Tongs, Grips & Slings

Downs Crane & Hoist Co.—24-page illustrated bulletin 200B describes hooks, tongs, grips and slings for handling or lifting of heavy objects and odd shapes and sizes.

60. Tool Room Grinding

Norton Co. — 162-page illustrated "Handbook on Tool Room Grinding" is guide to tool room operator or apprentice in proper selection and use of grinding wheels. Manual also serves to familiarize users with principles and methods of grinding various types of tools and cutters.

61. Foundry Equipment

Simplicity Engineering Co. — 16-page illustrated catalog "Simplicity Foundry Equipment" lists specifications and operating advantages of gyrating shake-outs, sand screening units, lump crushers, feeders and conveyors.

62. Electric Power Drives

Sterling Electric Motors, Inc.—8-page illustrated pictorial presentation form No. 170 depicts 70 applications of electric power drives to machinery installations and uses of geared drives at correct production speeds.

ADDITIONAL INFORMATION?

For additional information on any of the items described under "New Equipment and Supplies", "Trade Publications" or "Helpful Literature" in this issue — simply circle their corresponding item numbers on one of these cards.

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63. Lift Trucks

Lewis Shepard Products Inc.—Illustrated bulletin 26 covers line of hand lift trucks and Weldmaster skid platforms. Specifications and features of trucks in capacities from 500 to 15,000 lb and more are included.

64. Truck-Mounted Crane

Wayne Crane Div., American Steel Dredge Co.—8-page illustrated form No. 413 describes model 44 Corsair truck-mounted crane with ½-yard 10-ton capacity. Unit travels at truck speeds with ten speeds forward and two in reverse. Shovel, trench hoe, clamshell and dragline attachments are depicted.

65. Welding Alloys

Eutectic Welding Alloys Corp.—Illustrated 2 x 3-ft wall chart lists over 100 EutecRods and EutecTrodes with standard sizes and complete application data. Also available are form Eu-31 and bulletin EU-3 which discuss high-strength thin-flowing welding alloy for aluminum and low-melting point alloy for sealing and filling cast iron, respectively.

66. Chipping Hammer Tools

Arrow Tools — 4-page illustrated bulletin "Arrow Pneumatic Tools for Chipping Hammers" shows design and lists dimensions of blank, flat, cape, round nose and diamond point chisels for use in pneumatic tools.

67. Molding Machines

Herman Pneumatic Machine Co.—20-page illustrated bulletin "Herman Molding Machines" tells brief story of representative machine installation in leading foundries.

68. Hydraulic Lift Trucks

Barrett-Cravens Co.—8-page illustrated bulletin No. 5031 lists features of MD hydraulic lift truck having load capacity of 5000 lb with 6-in. lift and MX pallet model having 4000-lb capacity with 4-in. lift.

69. Special Foundry Equipment

Sutter Products Co.—4-page illustrated circular "Special Foundry Equipment" presents belt conveyor unit for sand delivery from conditioning room to molding station hoppers and power rollover and draw molding machines.

70. Propeller Fans

Clarage Fan Co. — 12-page illustrated catalog No. 510 contains information on selection and application of direct and belt driven propeller fans for specific ventilating services.

71. Tractor Loaders

White Mfg. Co.—4-page illustrated bulletin No. 36-B describes extensible boom bucket loaders or shovels which are available for use on wheel type Case, International, Oliver and Minneapolis-Moline industrial tractors.

72. Liquid Blast Cleaning

Pangborn Corp.—8-page illustrated bulletin No. 1400-A depicts Hydro-Finish liquid blast cleaning cabinet that utilizes modified form of impact blasting. Abrasive suspended in liquid is delivered to blasting nozzle by circulating pump.

73. Ventilating Fans

Schwitzer-Cummins Co., Ventilating Div.—8-page illustrated form No. 517 outlines features and gives dimensions and capacities of line of Fresh-Air Maker fans for commercial and industrial applications.

74. Conveyors

Logan Co. — 36-page illustrated guide "The Key to Lower Costs" presents 24 case histories showing economies effected by users of Logan conveyors, 16 typical handling problems and their solutions, 12 line sketches outlining functions of main types of conveyors and 50 actual installation views.

75. Aluminum Casting Alloy

William F. Jobbins Inc.—12-page illustrated bulletin "Almag 35" lists advantages, properties, composition, machinability data and other information on this aluminum casting alloy which is available in grades for sand, permanent mold and die casting applications.

76. Materials Handling

Powell Pressed Steel Co.—28-page illustrated folder file "Material Handling Equipment" covers line of lift truck platforms, box and box platform units, pallets, special handling equipment, gravity-feed hopper production box and all-steel collapsible container.

77. Horizontal Dust Suppressors

Whiting Corp.—4-page illustrated bulletin FY-165 gives features of Hydro-Clone compact horizontal dust suppressors for operation where headroom is at premium. Available in capacities from 2000 to 40,000 cfm, unit provides efficient wet suppression of dust and reduces it to easily disposable sludge.

78. Die Casting Machines

Kux Machine Co.—24-page illustrated catalog "Kux Die Casting Machines" shows design and gives specifications of air and hydraulic operated machines for lead, tin and zinc alloys; convertible machines with plunger gooseneck and cold chamber injection units for lead, tin and zinc base alloys and for aluminum, brass and magnesium alloys; and high pressure, cold chamber, hand ladling machines for aluminum, brass and magnesium.

79. Vibration Control Materials

Korfund Co. — 4-page illustrated catalog G-102 deals with characteristics of spring, rubber and cork types of vibration isolation media. Standard mountings with load ranges from 10 to 50,000 lb are described. Isolation selector chart is included.

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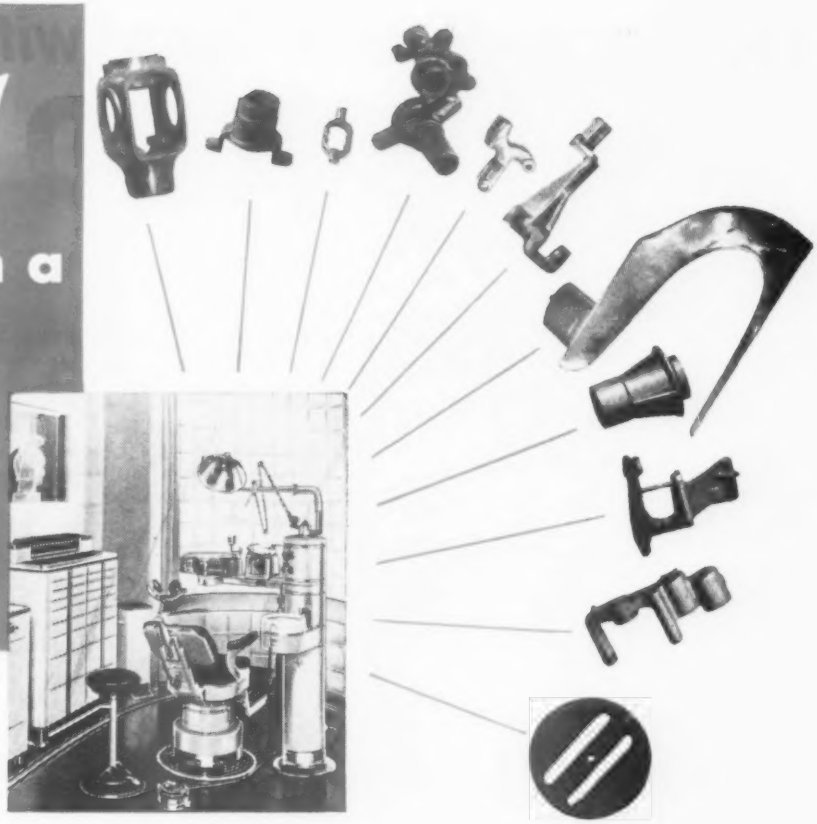

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S. S. White Dental Manufacturing Company, in its Staten Island plant, makes everything a dentist needs. A great many castings go into the making of chairs, tables, control and operating equipment.

Type LFC Detroit Rocking Electric Furnace. Capacity 350 lbs., melting nickel alloy iron.

All metal used in this wide variety of precise castings is melted in Detroit Rocking Electric Furnaces.

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Linings of these great furnaces last longer. Replacement linings, when necessary, are quickly installed.

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Foundry work moves faster with

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(*Continued from page* 196)

of the old cell, carbon is inert to electrolytic action and hence never will perforate, irrespective of battery age or degree of discharge. The new cell has no metal can to leak or corrode. It is said not to swell, stick or jam in the flashlight. Further claim is that the new battery provides more than twice the usable light of the old type.

For More Details Circle No. 13—Page 197

Bin Feeder: Simplicity Engineering Co., Durand, Mich. — Twin surface type bin feeder is designed

to keep bin contents in action so that bridging is eliminated and the entire surface of the bin is emptied at a uniform rate. Material is brought from the bin on two vibrating decks. Lower deck with a pitch of 5 degrees brings material from the far end of bin. Upper deck has a 3-degree pitch and carries material from the front of the bin. Feeders are available in sizes ranging from 12 in. to 6 ft wide, 5 to 40 ft long, with capacities of 30 to 250 tons per hr. Vibrating decks are powered through the inertia drive principle by electric motors of 1 to 15 hp.

For More Details Circle No. 14—Page 197

Hood: General Scientific Equipment Co., 2700 West Huntingdon St.,

Philadelphia 32—Protective hood is made with rubber-coated fabric said to be impervious to moisture, mo

acids, caustics, oils and solvents, and to protect against extreme temperature and light metal splashes. Hood is fitted with a large plastic window for easy visibility and protects the worker's face, head and neck from dangerous sprays or splashing. It may be worn with goggles or respirator.

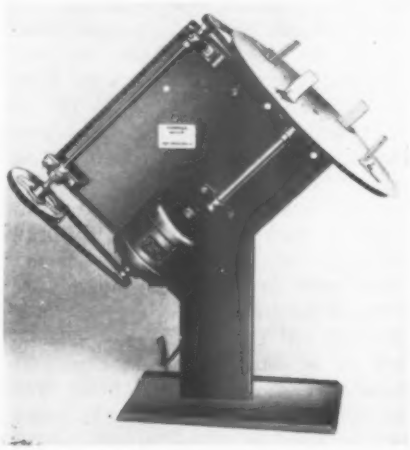
For More Details Circle No. 15—Page 197

Burden Carrier: Lewis Shepard Products Inc., 262 Walnut St.,

Watertown 72, Mass.—Pick-up truck of 1 ton capacity has 21 sq ft of loading space, is powered by a 20-hp, 4-cylinder high-compression water-cooled engine, and is governor controlled for speeds up to 20 mph. It has three speeds forward, one reverse, and is equipped with electric starter, hydraulic airplane type brakes, seat operated parking brake, T-handle steering, pneumatic tires, and two wheel drive through automotive type differential. Overall length is 98½-in. and overall width, 40 in.

For More Details Circle No. 16—Page 197

Tumbler-Mixer: Rampe Mfg. Co., 3029 Prospect Ave., Cleveland 15 — Tumbler-mixer, which can be



moved from one job to another, tilts through a full 90 degree arc so that the work can be tumbled at the best angle. The machine has adjustable turn table clamps that allow standard and odd shaped containers to be used. It will handle a 5-gal pail,

FOR FINE CASTINGS USE *Crucibles*

Photograph courtesy Jas. H. Matthews & Co., Pittsburgh, Pa., manufacturers of dies and fine Memorial Bronze. Melting equipment includes Nos. 400 and 175 Tilting Crucible furnaces, gas fired. Crucibles and Ladle Liners are used for carrying and pouring. Four bronze panthers as illustrated cast by Matthews guard park bridge in Pittsburgh.

Pouring a larger mold through two gates simultaneously demonstrates the flexibility of Crucible melting.

Melting is done in a large and a small tilting Crucible furnace and the metal is carried in No. 70 standard Crucibles (see illustration). Also used for carrying but not shown are preformed graphite ladle liners installed with insulation in standard steel shells.

Either Crucibles or ladle liners for carrying preserve the purity of Crucible melted metal.

Write for Crucible Melters' Handbook. Mailed Free.

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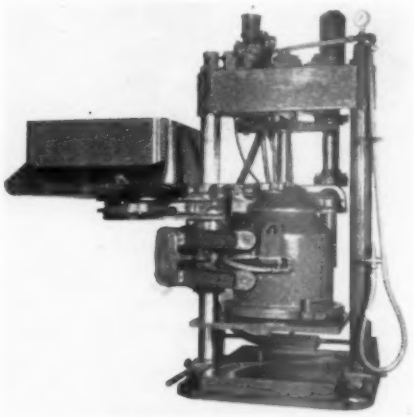
wooden box, can, jug, stone ball mill, laboratory beaker or any other shaped container. Regular octagonal tumbling barrels of steel or nonmetallic materials are available as extra equipment. Specifications include antifriction bearings, 1/6-hp motor and 19-in. turntable. Unit is 35 in. high and requires approximate floor space of 19 x 32 in. for proper and efficient operation.

For More Details Circle No. 17—Page 197

Sand Blower: Federal Foundry Supply Co., 4600 East 71st St., Cleveland 5—Automatic core blower operates on a new principle. Air enters the lower part of blowhead and completely mixes with a small amount of the sand. Motor-driven plows guide sand to one 1-in.-diam blowhole in center of blowplate through which it is carried by the air stream into the corebox. Sand in upper part of blowhead continuously falls into the airstream, replacing the sand blown into the corebox. Machine is designed to blow any type of sand capable of being hand rammed, up to 8 lb green compression strength and 8 per cent moisture content. All types of core boxes—metal or wood, open or closed—may be used with the universal blowplate containing one 1-in. blowhole. Unit operates on 80 to 100 psi air pressure, and blowing and clamping operations are controlled by one lever. Machine is available as a bench model without automatic draw table or floor model with 6-in. draw. Capacity of both machines is one 40-lb core or 40 lb of small cores without refilling or moving blow head. Hopper for refilling blowhead holds 200 lb of sand. Each machine will handle coreboxes up to 18 in. wide, 24 in. long and 12 in. high. However, if the core is to be drawn on the floor model, the maximum corebox height is 6 in.



For More Details Circle No. 18—Page 197

Shunt Connection: United States Graphite Co., Saginaw, Mich.—New permanent shunt connection for carbon brushes has been developed

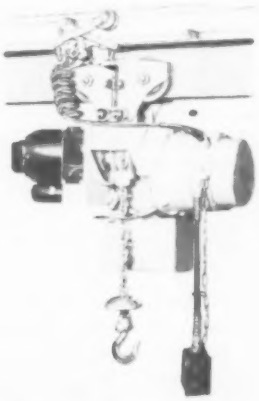
Tests under operating conditions have indicated the connection cannot be pulled or jarred loose from the brush, will maintain the original low millivolt drop, will not oxidize, and is unaffected by extreme operating temperatures.

For More Details Circle No. 19—Page 197

Conveyor Lubricator: J. N. Fauver Co., 49 West Hancock, Detroit 1—Lubricator automatically lubricates bearings in conveyor wheels which run on a T-beam. Four nozzles direct oiled air jets to both the inside and outside of each wheel bearing. Operation is entirely automatic. As each pair of trolley wheels passes the lubricator, they trip triggers which automatically release jets of oil-fogged air directly into the wheel bearings. A regulator with back mounted gage is used for establishing pressure of approximately 40 psi. Air pressure, volume of lubricant, direction and timing of "shot" are subject to easy adjustment.

For More Details Circle No. 20—Page 197

Hoist: Yale & Towne Mfg. Co., Philadelphia Division, Roosevelt Rd., at Haldeman, Philadelphia — New



chain type electric hoist offers lifting speeds up to 41 fpm, a lower as well as an upper limit stop, and a "pick up" angle of 30 degrees from vertical. Hoist is available in load capacities of 500, 1000 and 1500 lb. Standard models lift loads through any height up to 40 ft. Principal distinction of the hoist is that link chain, over an electrically-driven sheave, supports the load. This permits extra long lifting lengths since wound-up chain does not wrap around a drum but collects in a metal container as the hook raises. Hand controller is suspended by a light-gage chain so that neither electric cable nor electrical connections take the weight of the controller. Control cable carries only switch-energizing current, and not load current.

For More Details Circle No. 21—Page 197

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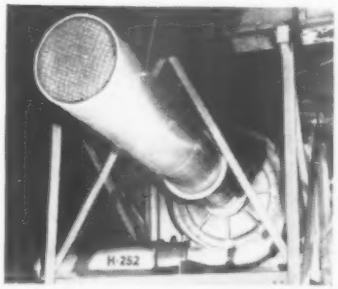
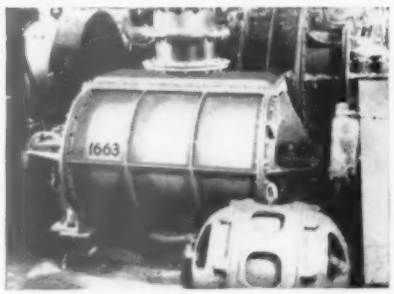


CENTRIFUGAL

Type OI Centrifugal Blower in foundry of large manufacturing company. Capacity 6,300 cfm.

Type RCS Rotary Positive Blower in heavy industry foundry. Capacity 4,500 cfm.

ROTARY



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WRITE FOR COMPLETE DETAILS

NIAGARA FALLS
Smelting & Refining Division
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BUFFALO 23, NEW YORK

Salt Bath Cleaning

(*Continued from page 91*)

long. The various bath tanks are shown at left in the cleaning section of the unit. The first tank into which the castings are lowered upon emerging from the annealing furnace is the one containing the molten caustic. This molten salt bath is an inert, quiet liquid consisting of 95 per cent caustic soda and 5 per cent sodium nitride and sodium nitrate. It is kept at a temperature of 800°F by electrodes immersed in the solution. The castings then are dipped in a water rinse followed by immersion in a 15 per cent muriatic acid solution, then a water rinse dip, and finally an oil dip. The oil emulsion consists of one part soluble oil to 20 parts water.

The salt tank has a capacity of 33,000 lb and is made up of an inner tank of heavy-gage low-carbon steel surrounded by a 6-in. layer of firebrick. An outside cover of sheet steel completes the tank. The other tanks have a capacity of 1300 gal and are made of steel. The acid and water tanks are rubber lined.

Trays Lowered Into Bath

Above each of the tanks is a dipping rack which lowers the trays of castings into the bath. A shuttling, pusher device moves the trays onto these dipping racks when they are in the up position. The five racks then lower the castings into the respective baths and the pusher moves back in preparation for pushing the casting carrying trays forward into position for the next bath when the racks are raised. In this manner the castings progress through the cleaning operation in the same four-minute cycle that governs their movement through the normalizing furnace.

When the trays of castings emerge from the final bath, they are pulled off the unload end of the unit onto a transfer car similar to the one used at the loading end. The castings are unloaded from the trays (Fig. 4) into skid boxes and/or onto a conveyor for transportation away from the cleaning area, and the empty trays are wheeled on the transfer car to the loading conveyor.

The entire operation of normalizing and cleaning takes about 2½ hours, and the unit will handle about 10,000 lb of castings per hour. These are gray iron castings, the largest being a section of the torque converter housing which weighs 50 lb

When the torque converter unit was in the development stage, the cast parts were designed with full knowledge that they would be cleaned by this salt bath method. Consequently all pockets and wells were eliminated from the castings so they would drain easily when taken out of the various baths. The series of baths removes all sand, scale and dirt from the castings and leaves a thin, protective coating of oil which retards rusting.

This special cleaning operation beyond the ordinary shot or sand blasting is part of an extensive effort to keep all parts of the converter unit as clean as possible. Eight washers are disposed about the manufacturing area to assure cleanliness of parts at appropriate stages of manufacture. The final assembly room is enclosed and furnished with filtered air under pressure to prevent entrance of any dust through the doors. All of these precautions are taken to be absolutely certain that no dirt will interfere with the proper operation of the precisely engineered mechanism in the torque converter unit. Because hydraulics is the basis of the unit's operation, extremely close fits in housing sections and in the operating mechanism are necessary. Presence of any dirt would seriously affect proper fluid flow and operation of the valves and other parts.

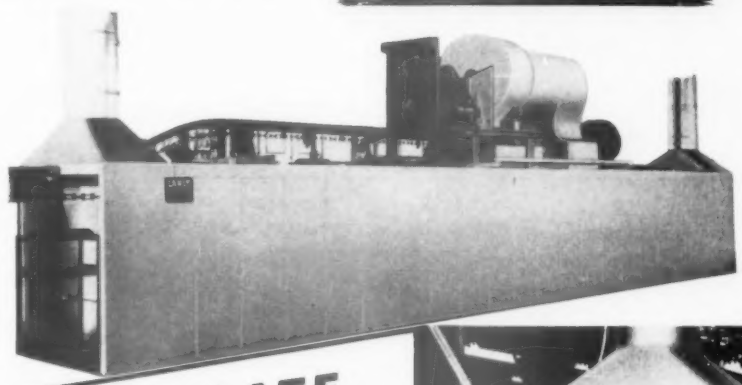
The normalizing-cleaning unit was installed by Holcroft & Co., Detroit, in co-operation with Hooker Electrochemical Co., Niagara Falls, N. Y. The immersion electrodes and temperature control system for the salt bath are by Ajax Electric Co., Philadelphia.

Opens New Safety Laboratory

Mine Safety Appliances Co., Pittsburgh, on June 14 dedicated a new research laboratory devoted to development of safety equipment for all types of industries. The four-story building contains varied equipment, including high altitude chambers; dust, fume, and gas chambers; a wind tunnel, and an electron microscope that permits study of dusts and other substances at 100,000 magnifications.

Principal speaker at the dedication, which included a display of the company's entire line of safety equipment, was Ned H. Dearborn, president, National Safety Council. William P. Yant is director of research and development for the company.

SMOOTHER CORES EMERGE FROM THIS LANLY Continuous Oven for Drying Cores after BLACKING



ELIMINATE Costly INSUFFICIENT DRYING, CORE OVERBAKING, FUEL WASTE, HEAT LOSSES & FIRE HAZARDS with a LANLY INSTALLATION

(Above) Overall view of LANLY Gas Fired Continuous Oven. (Lower Illustration) Close-up of entrance end showing carriers and fume sealing vestibule.

• Profitable improvement in core blacking resulted when this Lanly Continuous Oven was installed in a large modern foundry.

Ideal drying conditions prevail with the Lanly convection heating system that maintains a constant supply of heated air that is closely controlled in temperature, volume and velocity.

Whatever your immediate or anticipated foundry oven requirements may be, you'll be wise to consult LANLY. No expense or obligation to yourself. The chances are excellent that you will benefit in many ways by our broad experience.

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loaded with
outstanding
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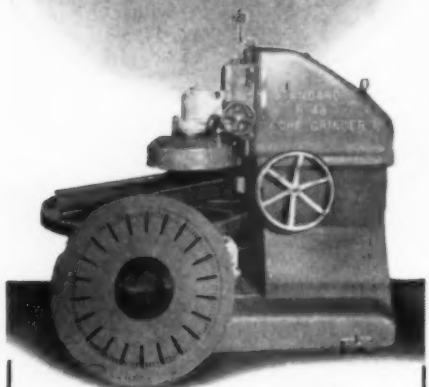

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Compact
—requires only 48" x 80" floor space.

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—rotary table mounted on precision sealed bearings. Easy to set up and adjust to various core heights. No clamping required.

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Shell Molds

(*Continued from page* 96)

ing unit, sprayed with a paraffin mold release solution, and positioned, face down, over a box filled with the loose dry molding preparation. The entire assembly was quickly inverted, causing the investment to fall and envelop the pattern face and plate. The resinous binder material softened under the influence of the heat of the mastern pattern plate and by virtue of its flow characteristics caused the resin-sand mixture to adjust itself closely to the outline of the pattern, building up a uniform coating which clings to the pattern face. After a 6-second period, during which the coating developed an even thickness of approximately ⅛ in., the assembly was inverted again, and the excess material fell back into the box, where it was used for the next molding cycle. The pattern plate with its adhering coat of set, but uncured investment, was lifted from the investment box, ready for the curing operation.

Cured in Oven

The plate and adhering coating were placed in an oven at a temperature of 570-600° F, and allowed 2-3 minutes for curing, during which period the resin component in the investment was converted into a hard, insoluble plastic which held the silica grains together strongly. After removal from the oven, the half mold, resembling a molded plastic product, was stripped from the plate. The half mold was a thin, even, shell of good strength and rigidity. A complete mold was assembled by pasting two half molds together. To aid in resisting mold deflection, and to control roughly the rate of solidification, the molds were bedded in some such material as steel shot, for casting. Cores were made in a similar manner, the investment generally being blown into a heated corebox, with the excess mold material slushed out to provide a thin, hollow core.

Molds were poured off in the usual manner. It was claimed that the plastic binder, in contact with molten metal, is reduced to carbon, and that mold gases passed with facility through the highly permeable mold walls. Molds and cores were said to be highly collapsible, and no burning-in of sand was experienced with the alloys handled. Little cleaning and no shotblasting were necessary.

The resinous compound utilized by Croning appears to be a two-step phenol-formaldehyde preparation. The

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TESTING EQUIPMENT:

Combination Rammer-Compression Tester—Simple way to prepare specimens to determine compression strength.
Permtester—A foolproof method for determining sand permeability.
Transverse Test Core Maker—For preparing core specimens for transverse tests.
Transverse Core Tester—Rapidly determines transverse strength of dry sand cores.
Baking Oven—Electrically heated, dries sand samples, bakes core specimens.
Moisture Tester—A reliable method of measuring moisture content.
Sand Mixer—For thorough preparation of sample core-sand mixtures.
Sand Washer—The easy-to-use method to determine clay content of sand.

Each of these testing units was designed to conform with the recommendations of the Committee on Foundry Sand Research of the American Foundrymen's Society.

Complete information upon request.

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material is in an intermediate stage of reaction called the "B" stage, and is referred to as a "Novolak." In this form, it is composed almost entirely of linear polymers. To bring about the cross-linking of the linear polymers, and the consequent hardening and fusing of the soluble resin to an infusible and insoluble material, hexamethylenetetramine ($(CH_2)_6N_4$) is added to the mixture. The "hexa" is decomposed under the influence of the curing temperature, in this case 570°-600° F, and yields formaldehyde and ammonia. The formaldehyde contributes the necessary excess to complete the reaction, and the latter catalyzes the polymerization, producing a hard, insoluble plastic. Resin compounds in the "B" stage should be stored in a cool, dry place or moisture will be absorbed. Heat will cause the material to lump and will result in subsequent difficulty in the blending operation.

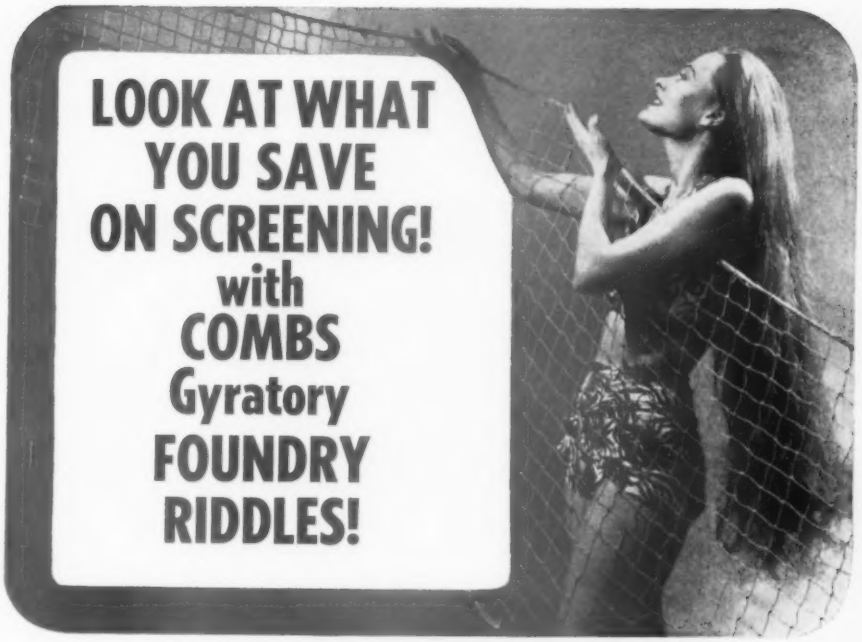
Several Resins Available

In addition to the original formula specified in the McCulloch report, one-step resins may be utilized. These resins also are supplied in the "B" stage but contain the necessary excess of formaldehyde in the preparation to complete the reaction. The authors have experimented with several two-step and one-step formulations in the phenol-formaldehyde class and several melamine formulations which will be discussed more fully in later paragraphs.

The primary objective of the investigation conducted by the authors, which was sponsored by the Bureau of Ships at the Material Laboratory, N. Y. Naval Shipyard, was to explore the applicability of heat polymerized plastics as sand binders, by this or related processes, for nonferrous or ferrous castings, and to develop suitable founding procedures and techniques for their possible utilization as molding media in Naval foundries. Development work has been planned along the following basic lines:

Mechanics of the process—This includes the design of suitable test patterns, moldmaking equipment, and auxiliary rigging, on an experimental basis, and the development of satisfactory founding techniques.

Metal quality evaluations—Evaluations are to be based on a study of comparative density measurements, X-ray examinations of thin sections, hydrostatic pressure tests, physical properties, of castings produced and surface character of test specimens cast by this and conventional sand-casting practice, in the light metals, bronzes, and ferrous alloys.



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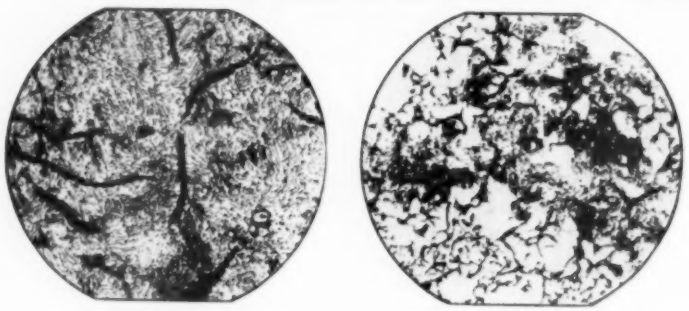

GOOD BAD

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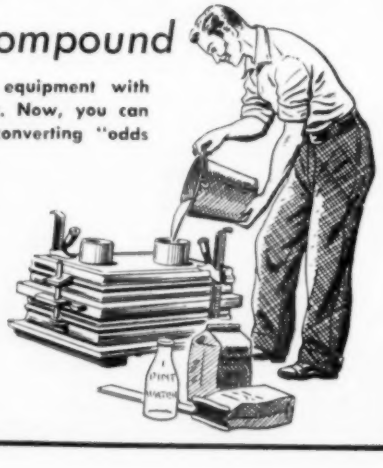

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Process utility—The method will be surveyed from a practical and economic standpoint, with a view toward determining the applicability of the process and the limitations in the character and size of castings which may be manufactured advantageously.

Process development—The possibility of improvements and beneficial variations in the basic techniques and materials will be explored in order to secure improved properties and economy of manufacture.

Experimental work—A wide variety of phenolic resin preparations were available and, initially, a material was procured which corresponded generally in chemistry and mesh size with the resin described by McCulloch. The initial type used was a finely pulverized two-step phenol-formaldehyde resin and possessed the following properties:

Gel time . . . . . 85-125 seconds
Flow . . . . . 70-100 mm
Density . . . . . 0.24-0.29 gm/cc
Melting point . . . . . 64-74° C
Mesh size approximately 200

In addition, a number of additional two-step and one-step resins were procured, some of which, particularly several one-step types, were subsequently found to develop superior moldmaking and casting characteristics. For the educational period, however, the former type was used almost exclusively.

Two types of silica sand were used for test. Both were New Jersey sands washed and dried, and of the sub angular grain class with the following sieve analyses:

Sieve No.	TYPE I* % Retained	TYPE II** % Retained
6	0.0	0.0
12	0.0	0.0
20	0.0	0.0
30	0.0	0.0
40	0.0	0.1
50	0.6	0.1
70	7.7	1.2
100	34.1	9.8
140	31.7	28.6
200	16.1	32.2
270	6.2	12.6
Pan	8.2	14.6

*AFS fineness No. 103.
**AFS fineness No. 151.4. Clay material in this sand averaged 1.2 per cent.

The second type sand produced castings with finishes superior to those produced in type I sand.

The requirements for moldmaking rigging and the techniques for operation were studied on a familiarization basis in the laboratory before full-scale pilot plant operations were attempted. A miniature pattern plate and pattern which consisted of a model sheave-type wheel mounted on a surface ground steel plate was utilized as illustrated in Fig. 1. For economic reasons, the pattern was mounted and gated in symmetrical fashion to eliminate the need for a

reverse half, although it was realized that the gating was not particularly appropriate for the casting design. It will be noted that the tapered locating bosses necessitate the use of steel insert pins for registering the two exactly similar mold halves. The steel frame at the upper part of the photograph substituted for the required investment box, the dry molding material being poured on the plate, with the frame acting as a barrier to the escape of the loose powder. Excess material, unaffected by the heat, was removed by reversing the plate, leaving a ¼-in. thick coating adhering to the plate and pattern face.

Sample investment preparations were made and tested, in which numerous deviations were made from the original formula, with a view toward obtaining a base preparation which would be most satisfactory from the standpoint of mold quality. Initially, variations were made in sand fineness, percentage of resin in the formula and mode of investment preparation.

Molds Made Experimentally

A quantity of molds were made experimentally with the model rigging under varying conditions of time and temperature for setting and curing cycles. Elements of mold character such as strength, glaze, thickness, detail and sharpness, surface hardness and friability were studied. Observations were made on the effectiveness of the paraffin mold release agent specified in the McCulloch report, and experiments to provide a more efficient parting agent were carried out. A number of half molds (as shown in Fig. 2) were assembled with "C" clamps, bedded in steel shot and poured off in an aluminum alloy, tin bronze, monel, and carbon steel from heats of production metal. All molds poured and vented well, without "kicking" or other unusual phenomena. Considerable carbonization was noted on the outside of the mold walls after pouring, particularly with the higher melting point alloys.

All molds disintegrated with ease during casting shakeout; the castings broke cleanly with little or no adhering material. Surface examinations of a number of these model castings in all the alloys noted indicated the fundamental impropriety of the gating in that metal impingement upon the mold had promoted slight washing in the ingate area. In addition, some "searching" was found on the bronze castings, and some evidence of burning-in and roughness on the steel specimens. The monel sheaves showed some surface dross. All alu-

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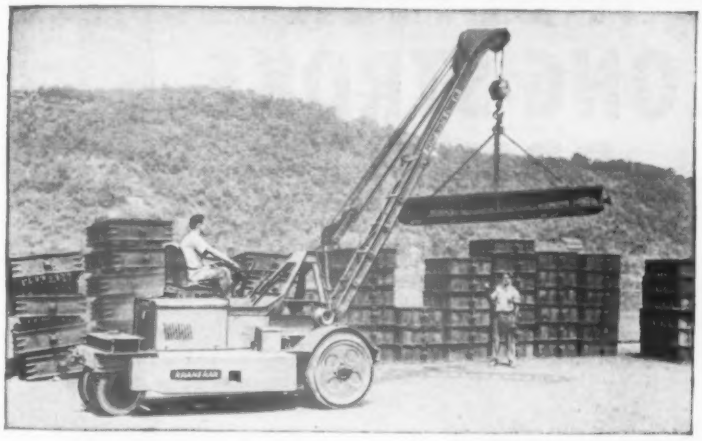

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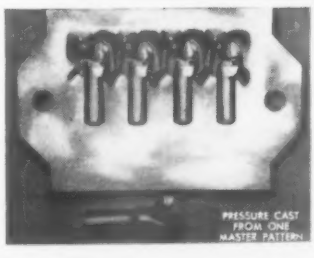

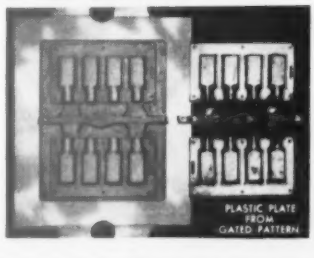

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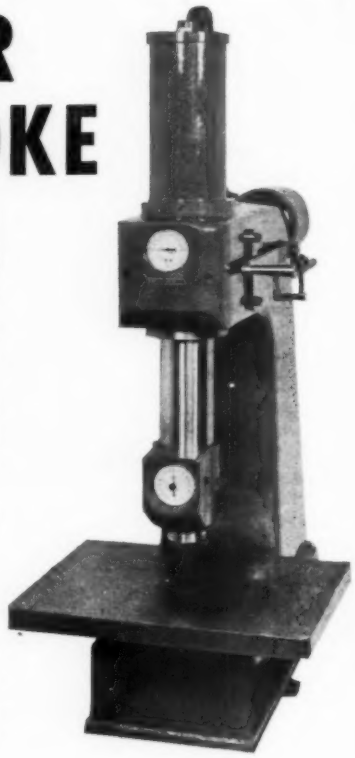

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minum alloy sheaves yielded a fairly good surface finish. The results, however, were not without promise, particularly in that casting edges and contours were sharp and showed good fidelity to the pattern, and in no case did mold failure occur. Examples of a number of these specimens in both the as-cast and lightly shot-blasted conditions are shown in Fig. 3. In general, the results of this educational survey, which is discussed only superficially in the foregoing, were considered sufficiently favorable to proceed with full scale experimental equipment.

Full scale experimental work—The moldmaking rigging for the pilot plant operations was designed for manual handling and was relatively simple in character. The major items consisted of:

(a) Ten-in. by 12-in. pattern plates, cast in a heat-resistant, low expansion alloy iron. Plate sections were uniform and ½-in. thick and somewhat overdesigned in anticipation of severe treatment. The plates were planed off and surface ground preparatory to pattern mounting and fitted at the handles with flask-type threaded pins for locating and securing the investment holding box during mold reversal.

(b) An investment holding box of welded aluminum construction contoured to the outline of the pattern plate, and fitted with handles drilled out for locating on the plate.

(c) An aluminum buffer frame, resembling the investment holding box in contour, but having no bottom, and of lesser height. Fitted with drilled handles like the latter, it was positioned between the heated pattern plate and investment box to perform the double service of shielding the latter from the heat of the plate and eliminating possible sticking of uncured mold edges to the blind edges of the investment holding box during the setting operations. Auxiliary items included spray equipment, clamps, and pyrometric equipment designed to yield instantaneous surface temperature readings.

The first pattern selected for trial mounting was essentially a flat, drafted test plate with integral sink-head, a design which was considered favorable for extracting tensile, density, X-ray and hydrostatic pressure specimens. The two halves of the gated pattern were machined from steel, with all pattern corners deliberately left as sharp as practicable, and located and bolted with extreme matching accuracy on the two plates. Two tapered bosses were mounted on opposite corners of one plate, and the corresponding recesses bored out in

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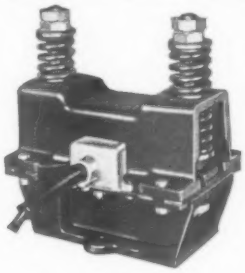

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the proper locations on the other. The gating arrangement was such that any tendency for the mold material to cut and wash would be apparent. The basic assembly, iucluding the investment holding box is illustrated by Fig. 4.

A large quantity of molds were manufactured with this equipment, and detailed data were secured from the mold runs. Such information generally included furnace curing and setting temperatures, actual plate temperatures secured by pyrometric equipment, setting and curing time periods, stripping factors, mold appearance and character, and the details of investment composition and preparation.

The techniques and sequences which were considered most successful, as determined by an evaluation of the accumulated data, follow:

Investment formula—Both 100 AFS and 150 AFS fineness sands were used. The former generally yielded a strong, sharp mold of good surface appearance, while the latter showed increased smoothness and close grain, but required additional resin for binding. The formula generally used at this stage was 8 parts by weight of the two-step phenol-formaldehyde resin described earlier, to 92 parts of 100 AFS washed silica sand, or 91 parts of 150 AFS silica sand to 9 parts of resin by weight. Subsequently, a number of additional types of two-step and one-step resins were tested, and at least two types of one-step resins were found to have moldmaking and casting properties superior to the original. The phenol-formaldehyde resin found most suitable to date was a one-step type, with an anti-sintering agent added incorporating the following properties:

Gel time	60-80 seconds
Flow	45-70 mm
Density	0.27-0.33 gm/cc
Melting point	55-70° C

It will be noted that the material has a shorter flow than the original resin specified in the Fiat report.

Investment mixing — Rapid and thorough blending was secured with a paddle-type dough mixer with planetary action, which performed with a minimum of dusting, and required little cleaning after use. Some dusting, however, particularly of the fine light resin was experienced, and the use of a protective dust hood was found necessary.

Storage may have a profound effect on the "B" stage resin compounds in that exposure to dampness or warmth results in caking or even sintering. Hard caked lumps are not broken with facility in paddle-type mixers, and generally make for poor-

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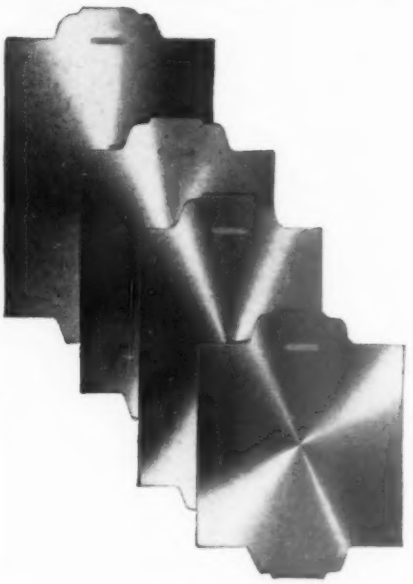
ly prepared mixes. Storage in cool, dry areas is recommended. Additions of antisintering agents made by the resin manufacturer to the "B" stage resin appear to prolong the useful life of the resin during storage.

Preheating the pattern—The plate and attached pattern were placed in a furnace and heated to a surface temperature of 400° F.

Setting the investment—After removal from the furnace, the pattern plate was quickly sprayed with a mold release solution. The release agent found most successful to date was a silicone jelly in a methyl/ethyl ketone, naphtha or carbon tetrachloride solution, generally 15 per cent of the jelly by weight. The silicone spray, which appeared to be much superior to the paraffin solution mentioned in the McCulloch report, almost completely eliminated the frequent mold sticking which was often encountered with the use of the latter. Practically chemically inert, and stable at the temperatures employed, one spray application was found sufficient for the stripping of at least four to five mold halves. Following the spray, a buffer frame was placed over the pattern plate, and the plate inverted and placed over the investment box (Fig. 5) using the handle pins for registry. The handles of plate, buffer, and investment box were grasped together firmly by the operator, and the assembly quickly reversed, (Fig. 6) during which operation the powdery preparation which had filled the box to within 2 inches of the top, fell upon the hot plate face, softened, and began to conform to the contour of the pattern. Following a brief wait for adequate shell buildup (generally 12 seconds for approximately ¼-in. thick wall) the operator grasped the nested handles and reversed the assembly once again. The pattern plate and buffer frame were then lifted vertically from the investment box, placed face up, and the buffer removed. The pattern plate with its adhering coat of "set" investment was now ready for curing (Fig. 7).

Curing and stripping—The plate and "set" coating were placed immediately in a furnace for a 2-mintue curing period at 600° F. The plate then was removed from the furnace, and the mold shell easily stripped by gently rapping the sides of the plate, and lifting the mold vertically with a flat tool, such as a scraper. A production molding arrangement, would of course utilize stripping or knockout pins to provide a rapid, facile mold removal mechanism. Fig. 8 illustrates lab-



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oratory stripping practice.

Mold appearance—Fig. 9 shows a pair of typical mold halves as stripped. Generally, the mold thickness averaged ¼-in. for a 12-second setting period. Varying the setting time from 6 to 16 seconds produced mold thicknesses of ⅛ to 5/16 in. The cured shells ranged in color from a bright yellow to a yellow-tan, depending on the resin employed and the curing time. Mold faces were lightly to highly glazed, and relatively non-friable, yielding scratch hardness readings of 92 to 98. Corners were sharp and clean, and the detail was excellent. Mold edges were fairly firm. The shells were rigid and strong, and could be handled and stored easily, and without damage.

Mold assembly and pouring—Molds were registered by corresponding locating bosses and cavities on opposite halves, and fastened together firmly with small "C" clamps. The matching of halves is positive in every case, and if the pattern mounting has been accurate, mismatches are necessarily eliminated. For pouring off, the molds were lined up vertically in a container, and blasting grit poured around them, as shown in Fig. 10, to provide support. Following pour-off, the molds carbonized rapidly in the cavity areas. In no instance did mold failure (swelling, metal breakout, runout at joint, premature collapse, etc.) occur. The molds disintegrated easily on casting knockout. No cleaning or surface preparation was found necessary for aluminum alloys other than a soft brushing to remove loosely adhering sand.

Experimental casting data — X-ray examination of these plate castings indicated a comparative quality, from the standpoint of internal soundness, with plate castings made in conventional sand molds. Surface examination of 36 aluminum alloy test plates poured at 1250-1280° F indicated excellent surface finishes, superior to production sand-cast products, with unusually sharp edges and detail. Linear shrinkage was normal for the alloy employed. Precision measurements taken on 15 plates selected at random showed good dimensional reproducibility in which the maximum spread was 0.007-in. On 14 of these 15 castings, the maximum spread was 0.005-in. Readings made on surfaces of varying smoothness on sample castings, with a Brush analyzer yielded values ranging from 65 rms to 190 rms. The weight of the test plate and attached runner averaged approximately 3 lb. Typical plate castings in 356 aluminum alloy which were poured into plastic bonded molds made with 150 AFS fine-

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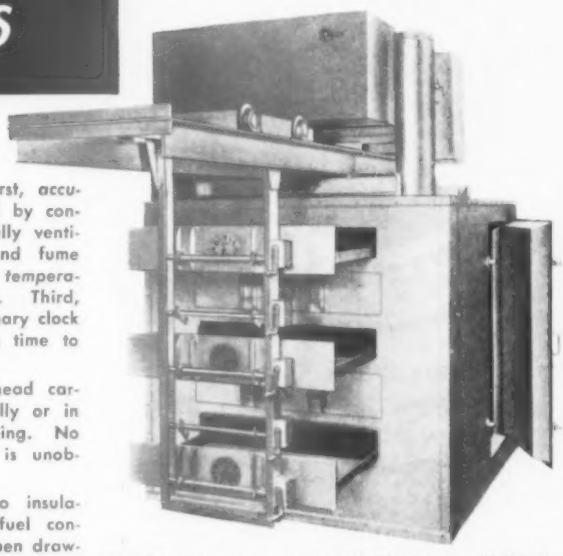

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ness sand, are shown in Fig. 11.

Production type castings—For a preliminary examination of the possibilities of the process for the production of items in any alloy, an impeller type casting was selected. This particular design was chosen because it has the elements of thin sections and vanes, heavy sections and a relatively high draw. In addition, designs of this type may be of interest to founders in the stainless and high temperature field. In the interest of economy, the master pattern was rough cast in bronze, hand finished and vapor blasted, with no special effort to provide for proper draft on the vanes. For positive mold stripping, the pattern was fitted with ejection pins which were manipulated manually. Rubber rings were provided to prevent the pins from descending during the rollover. The drag pattern and plate are shown in Fig. 12.

With this temporary experimental rigging a number of molds were made following the general techniques described for the test plate molding. The molds stripped well, despite a condition of slight backdraft on several vanes. In spite of the almost razor edges of the vane tips, and the thin (1/10-in.) vane tops, sufficient mold thickness was built up in those areas without difficulty. The molds were sharp and clean and detail was reproduced with high fidelity. A sample drag half is illustrated by Fig. 13, and the assembled mold, with a flat cope and fitted with a gypsum riser, is shown in Fig. 14. On aluminum alloy and bronze castings the gypsum was used to promote feeding of the hub area. A sand core was used, together with additions to the riser of an exothermic feeding compound, on ferrous castings.

Molds were bedded in shot in the usual manner, and poured off in 356 aluminum, gun metal bronze, gray iron, medium carbon and stainless type steels. The aluminum and bronze castings ran out to exceptional sharpness and high detail, with surface finishes that were much superior to those obtained by conventional sand practice. These castings with the riser removed weigh about 2 lb in aluminum and 6½ lb in bronze.

Both the aluminum and bronze castings in the larger sizes, and depending on the gating system employed, showed a surface dross condition. In the aluminum alloys it is only a very fine surface film readily removed. In the large bronze castings this condition can be recognized in localized areas after cleaning. X-ray examination of the aluminum impeller wheels and gamma-ray inspection of the bronze impeller wheels indicated freedom from objectionable internal unsoundness. Photographs of castings in 356 aluminum alloy and Navy gun metal in the as-cast and vapor blasted condition are shown in Figs. 15 and 16 respectively.

Surfaces of these impeller wheels poured in gray iron were highly satisfactory and superior to conventional gray iron surfaces produced in sand molds. However, a slight tendency toward pinholing was evidenced which may be attributed to localized spot concentrations of resin which were not sufficiently cured. Gamma-ray inspection of these gray iron impeller wheels poured with a sand core for the riser, as shown in Fig. 14, indicated freedom from objectionable unsoundness.

The mild carbon steel and stainless steel castings, however, showed a shrinkage area in the hub section. The knife edges on the vanes did not "run," and the surfaces, while comparable with sand castings, did not indicate any unusual advantages from the standpoint of surface finish in these alloys at the current state of development for this process.

Investigate Further

Another typical casting currently being investigated for manufacture by this process, and which is fairly representative of items in the bronze valve field, is a simple by-pass casting. The master pattern plate arrangement equipped with spring operated ejection pins, and the booked core box is illustrated in Fig. 22. A sample drag and cope with core in place is shown in Fig. 17. A sample casting poured in gun metal bronze at 2100°F from these thin shelled molds is shown in Fig. 18. Gamma-ray inspection indicated freedom from internal gas porosity and shrinkage with the gating system employed.

For investigation of the metallurgical characteristics of the tin bronze alloys as affected by plastic bonded shell molds, a master pattern plate of the Navy Department Fig. 10A design is being utilized as shown in Fig. 19. The effect of variations in shell thickness, pouring temperature and grade of steel shot on the mechanical and physical properties of the bronze alloy, is being investigated. In addition, wedge castings are being produced in order to study, by X-ray examination, the effect of the above variables on internal unsoundness and the extent of the chilled skin formation. Two half molds and the as-cast test bar are shown in Figs. 20 and 21, respectively. The same

variables, and their effect on the physical properties of a heat treatable aluminum alloy, are also being studied. In this instance a master pattern plate of the test bar design shown in Fig. 2 of Navy Department Specification 46A1 is being utilized.

Discussion

Investment materials — A number of phenol-formaldehyde base resins of both one-step and two-step types were tested for a determination of their mold making and casting properties, following the standards discussed in previous paragraphs. To date in the opinion of the authors the most satisfactory phenol-formaldehyde resins have been two single-step types with moderate flow characteristics. One of the two has an antisintering agent added which appears to prolong storage life. The words "moderate flow" are used in a relative sense since it appears that the plastics manufacturers perform flow tests in varying fashions. In this regard many of the resin manufacturers are conducting research in an effort to produce a resin material which will be "tailor-made."

It is the opinion of the authors that the flow characteristics and melting range of the resins employed are two important properties which must be defined and controlled. Both low and high flow resins yielded casting surfaces inferior to the resins with moderate flow characteristics. Molds with a high surface glaze indicative of high resin concentration on the hot face, and which appeared exceptionally smooth, did not yield the ultimate in surface finish of the casting produced. This may be due to decomposition of the high resin content at the mold surface, causing slight metal penetration. At any rate, it may not be far afield to assume that different types of castings will require resin bonding agents with different flow and melting range characteristics in much the same manner that sand mixes and bonding materials will vary today with the alloy and casting design in conventional sand practice.

Other types of thermo-setting resins, for example the melamines, are being investigated, and although the investigation is incomplete, a certain amount of promise is indicated. In addition, the effect of fine refractory materials such as silica flour, or milled zircon, added to the sand-resin mixture or utilized singly with the resin bond, is being investigated. At present no advantages appear to be derived from the use of as much as 10 per cent silica flour added to the 150 AFS sand-resin mix-

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ture. A study of the effect of grain shape on casting finish is also being carried out.

Pattern equipment—The pattern and plate materials used to date have been principally of alloy cast iron or mild steel. For the sake of economy, hand finished bronze castings were adapted for patterns on one or two occasions, but these proved to be subject to scratching, nicking or swaging to a degree not normally experienced with iron or steel. Cast iron of the low expansion, heat-resisting type appeared to yield the best overall performance, particularly from the standpoint of resistance to sticking. This may be due to its high graphite population on the surface.

Design Special Plates

Pattern plates should be designed with uniform sections and with sufficient thickness to retain the proper temperature head for setting the investment on a continuous operating basis. Generally, rivet type heads are utilized for stripping pins, and the wider the area of each head, the more efficient the stripping action, provided they are spaced uniformly around the plate. Stripping pins on a production pattern should, of course, be outside the mold cavity and equipped with springs for automatic return after release of the plastic bonded mold. Usually the pattern plates are cored and this provides an air space and some insulating value.

Thin sections on a high point of a pattern may give some difficulty in maintaining a suitable surface temperature on a continuous molding basis. On patterns of this type, or for that matter conventional patterns, the use of heating elements in the master pattern plate should be considered. Generally, mold halves are completed from start to strip in approximately 3 to 4 minutes with a pilot plant nonmechanized rigging. It will be recognized, however, that the cycle may be interrupted on occasion for pattern cleaning, particularly when poor stripping or investment sticking is encountered, and caked material must be removed from corners and pockets. When this occurs, it probably will be found necessary to preheat the pattern plate again for a sufficient period to come within the proper setting temperature range. The normal curing period may be utilized productively by alternating two or more plates so that molds may be set while others are passing through the curing cycle.

A crude type of rollover gear utilized initially pending the construction of a more elaborate design, is shown in Fig. 23. Other types, as exhibited at the recent Foundry Show in Cleveland (see page 170), which incorporate a large dump box with water-cooled flange and no buffer may be employed. In any design or arrangement however, sufficient burden should be provided with a drop of at least 8 in. It may be advantageous, too, to incorporate mechanical baffles which will release the burden after the reversal of the pattern plate has been completed so that a vertical drop is effected over the entire hot face simultaneously.

The largest single item of expense in the founding of a casting by this method is, without doubt, the cost of manufacturing the pattern equipment. Work is being done by the authors to investigate the possibility of securing appreciable savings in machining time and expense by the use of easily worked materials suitable for the master pattern plate at elevated temperatures.

Mold release agents—As indicated previously in the experimental procedure, the mold release agents which have yielded the best results are the silicone jellies (15 per cent by weight) in an ethyl methyl ketone, naphtha or carbon tetrachloride solution and applied as a spray. The number of free draws obtainable from each application will vary with the solution strength and spraying technique. With the technique employed in this investigation, four to five strippings are safely made. The mold release properties of a number of agents for use in this process have been tried and they include the stearates, molysulfides and the synthetic polyethylene glycols. The polytetrafluoroethylene compounds show promise and definitely should be considered as a possible mold release agent.

Mechanization — Favorable opportunities exist for a complete mechanization of the molding system on high production runs. Molding machines, conveyorized furnaces, infra-red heating, dielectric heating, mechanical stripping, and heating elements in the master pattern plates are a few possibilities which doubtlessly will be explored by production engineers, if the method is found practical.

Plant safety—The pulverized resins and fine silica sand in the investment preparations may constitute a respiratory hazard to the molding room operators. Gases, including ammonia, liberated by the resins during mold curing are similarly unpleasant, and require adequate ventilation. The mixing of investments should be done under hoods, or with dust-guard protection. Additions of wetting agents

to the mix may, however, tend to resist dusting and resin segregation. Odors emitted by decomposing molds during and immediately following pouroff are extremely acrid. The possibility of contact dermatitis also should be considered, particularly when handling phenolic resins containing hexamethylenetetramine.

Gating and heading—Sound principles of gating and heading cannot be ignored in this or any other casting process, if castings free from objectionable internal defects are to be manufactured.

Generally, it is believed that yields can be improved by this process due to a better control of solidification trends and the facility for using backing materials of known thermal conductivities in certain critical areas. Due to the high permeability of the thin shell molds and backing material, the gases generated from the decomposing organic binder are adequately vented with very little back pressure. This, coupled with low frictional losses due to the smooth mold face, permits the running of sections which normally would be a problem in conventional sand molds.

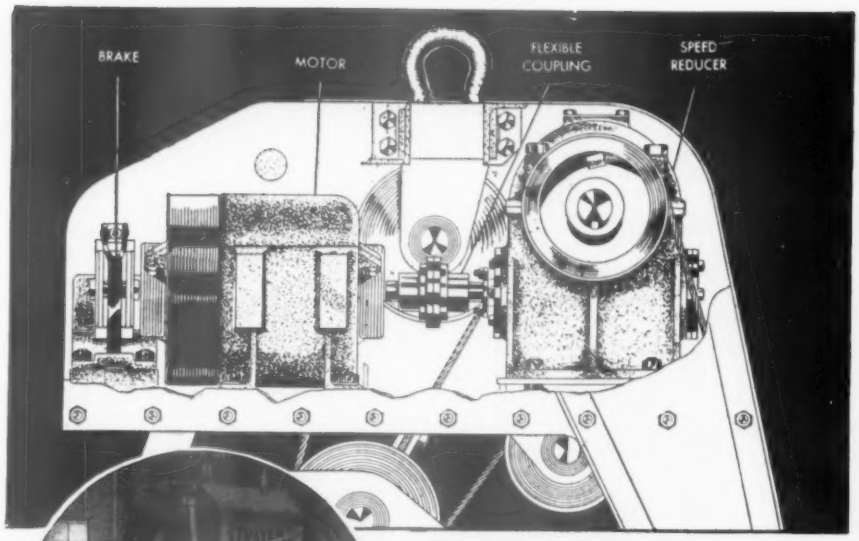
The apparent stability of the finished molds with regard to resistance to deterioration and moisture absorption, coupled with their structural strength and lack of dimension change, make them particularly suitable for storage over indefinite periods. Consequently it may be practical to consider the storage of large quantities of molds for critical casting work, or the shipment of molds between plants thus reducing duplication of master pattern equipment.

It is the opinion of the authors that, in general, based on the work accomplished to date, the process described herein, properly applied, can be considered to be an economic and productive molding medium on long run or a repetitive class of work such as valves, fittings, plumbing goods and diesel engine parts and should receive the earnest consideration of foundry management. At the present state of development, however, it is considered that the process is best suited for the nonferrous alloys and cast iron.

Note: Published with permission of the Navy Department. The opinions or assertions contained herein are those of the authors, and are not to be construed as official, as necessarily reflecting the views of the Navy Department, nor as an endorsement by the Department of the process discussed herein.

References

1. FIAT final report No. 1168, The "C" Process, William W. McCulloch, U. S. Government Office of Technical Services. Condensation of this report presented in THE FOUNDRY, October, 1948, p. 130.
2. Translation of a report on the "C" Process by Professor Piwowarsky, *Foundry Trade Journal*, Feb. 19, 1948, p. 181.



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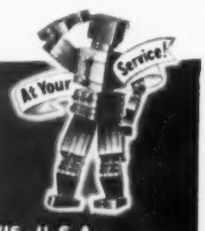

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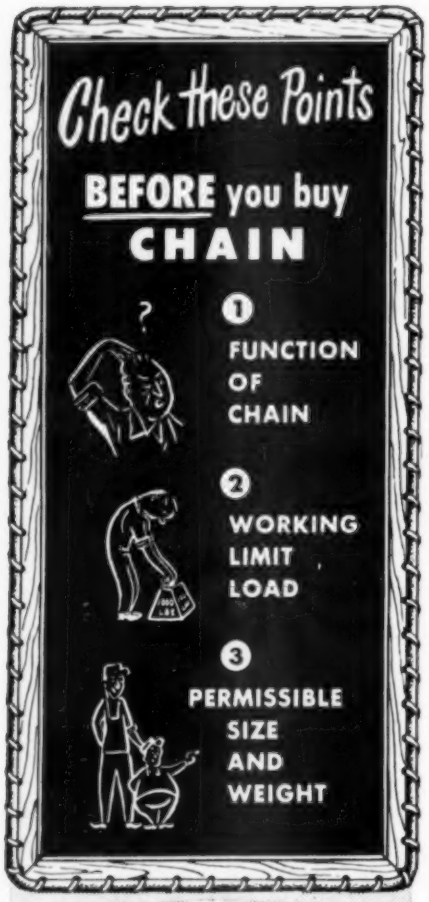

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With the EDITORS

WAR EXPERIENCE: The past few weeks have brought back memories of 1941 and early 1942 experience to those who spent some time during World War II in the government service at Washington. In those early days of the emergency, the progress in developing plans for war procurement was terribly slow, and industry had a difficult time in finding ways to render maximum service to the government. Today many leaders of industry are visiting the Capitol in the hope of finding out what is wanted in the way of industry production and how the individual organizations may gear into the needs of the program. In the main these visits have been disappointing for as yet plans for the overall needs of the various government agencies have not jelled. Many observers of the Washington scene believe that industry has profited from the many lessons learned during the past war, but doubt if government will find it possible to benefit fully from past experience in organizing for war mobilization.

—o—

Safety Consciousness: Every now and then, one of our good friends in the industry will take us to task for using a photograph for illustrative purposes which does not quite measure up to the ideas of good safety practice. Either the worker is not provided with proper safety equipment, or he may be violating safety principles. Now it seems that the readers of newspapers are inclined to criticize such illustrations.

Washington Editor Ed Kreutzberg, recently noted the photograph reproduced below in a local newspaper. It shows a demonstration of the production of aluminum castings in sand molds, and was taken in the foundry of an eastern university. A few days later the following appeared in the reader's comment section.

Foundry Dos and Don'ts

The picture appearing on page A-20 of *The Star* for Mar. 18 should bear the caption: "What not to do in a foundry." Since I've been old enough to listen to and understand safety precautions, my father has drummed into my head a fairly good set of "dos" and "don'ts" for a foundry. I say they are fairly good because they've kept him in good health through 30 years of foundry work, most of which have been spent in teaching high school students.

Some of the things I have been taught are listed here for what they are worth. I'm only listing the items which appear in your picture as violations of the rule.

Never pour without wearing goggles.
Never pour without wearing gloves.
Never pour without wearing leggings.
Never pour with sleeves rolled up.
Never kneel when pouring.
Never allow observers within 30 ft of pouring.

One wonders about the rest of the Industrial Education Department at the University of Maryland after seeing such a perfectly horrible example as pictured in your paper.

W. C. Doe

Let us hope the workers in the plant are as critical.

—o—

Recognition: John Howe Hall, author of many articles presented in this publication, including the present extensive series on steel foundry practice, was honored at the recent annual meeting of the American Society for Testing Materials for having been a member of that organization for 40 years. "Jack" has seen many changes in the castings' specifications in that time.—F.G.S.

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For More Details on these Items Use Reply Card—Page 197

FOUNDRY ENGINEERING: Lester B. Knight & Associates Inc., 600 West Jackson Blvd., Chicago 6—Booklet tells about the company organization, lists qualifications of its engineers, and outlines its consulting engineering service in foundry engineering, foundry layout, architectural planning, foundry modernization, foundry management, production and cost control, and industrial engineering in job evaluation and incentives.
For More Details Circle No. 90—Page 197

FIRE CLAY: Illinois Clay Products Co., 68 North Chicago St., Joliet, Ill.—Folder deals with fire clays for cupola, open hearth and blast furnace use; fire brick for lining iron and steel ladles, furnace construction and general mill and foundry purposes; and a product for insulating exposed brickwork of open hearth and other furnaces.
For More Details Circle No. 91—Page 197

SAND EQUIPMENT: National Engineering Co., 549 West Washington Blvd., Chicago 6—Bulletin 504 describes a sand recovery system which operates on the principle of decarbonizing used foundry sand to furnish reusable sand of good physical characteristics. Bulletin 492 covers a portable sand mixer with adjustable muller weights for mixing core sand or steel sand facing.
For More Details Circle No. 92—Page 197

DEHUMIDIFICATION: Abbeon Supply Co., 58-08 41st Drive, Woodside, New York—Folder discusses dehumidification for industry. It explains relative humidity and its effect on various products. It tells how to remove moisture from air and describes a piece of equipment offered by the company for that purpose.
For More Details Circle No. 93—Page 197

ELECTROSTATIC PRECIPITATION: General Electric Co., Schenectady 5, N. Y.—Bulletin GEA-5212 explains how electrostatic precipitation works for air cleaning, gas cleaning and recovery, painting, deposition, orientation, and separation. It describes methods of electrostatic precipitation and the electric equipment applicable to each method.
For More Details Circle No. 94—Page 197

STEEL REFERENCE CHARTS: Lebanon Steel Foundry, First Ave. & Lehman St., Lebanon, Pa.—Two revised steel casting reference charts cover 33 selected grades of carbon and low alloy, stainless, corrosion and heat resistant alloys. Company grade designations are listed with comparable designations of Alloy Casting Institute, American Iron & Steel Institute, American Society for Testing Materials, Hydraulic Institute, Society of Automotive Engineers, and U. S. Navy steels.
For More Details Circle No. 95—Page 197

PLASTIC CORE BINDERS: Borden Co., Chemical Division, 350 Madison Ave., New York 17—Bulletin T-27-111, "Plastic Core Binders and Workers' Health," discusses effects of various core binders on workers' health, suggests preventive measures and outlines treatment for cases of irritation.
For More Details Circle No. 96—Page 197

BONDING RESINS: Bakelite Division, Union Carbide & Carbon Corp., 30 East 42nd St., New York 17—Data file deals with urea and phenolic sand core bonding resins for ferrous and nonferrous metal castings. It contains bulletins describing properties, advantages, and fields of application of these resins.
For More Details Circle No. 97—Page 197

ALLOY CASTINGS: Cooper Alloy Foundry Co., Bloy & Ramsey Ave., Hillside 5, N. J.—Six-page folder contains analyses of stainless, corrosion and heat resistant alloy castings. It gives ACI, AISE, SAE, ASTM, and other designations, alloy properties at room and high temperatures, and discusses applications.
For More Details Circle No. 98—Page 197

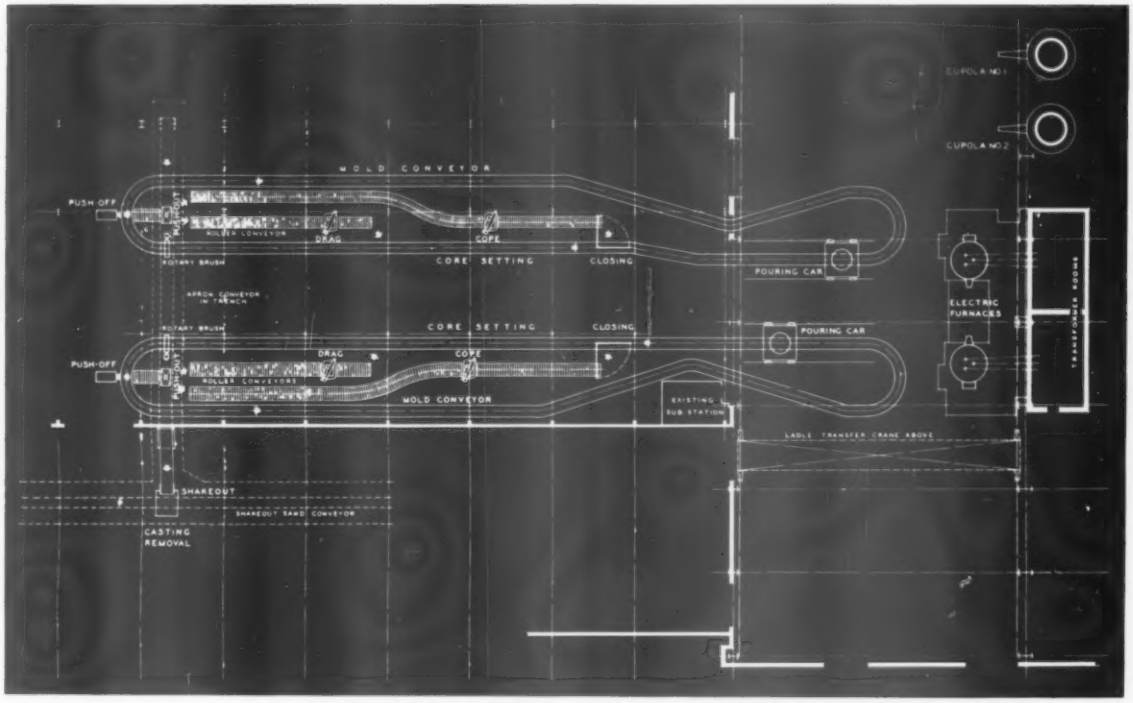
SAND CONDITIONING: Royer Foundry & Machine Co., 159 Pringle St., Kingston, Pa.—Illustrated bulletin 744 presents information on construction and design features of the company's line of sand separators and blenders. Weights, dimensions, motor sizes and capacities are given for each of the models manufactured.
For More Details Circle No. 99—Page 197

CONVEYORS: Goodman Mfg. Co., Halsted and 48th Sts., Chicago 9—Illustrated bulletin IMD-498 describes shaker conveyors for moving abrasive, hot, wet, fine, or bulky materials on the level, upgrade or downgrade, for distances up to 500 ft with a normal capacity of 100 tons per hour.
For More Details Circle No. 100—Page 197

BUSINESS POLICY: Arthur D. Little Inc., 30 Memorial Drive, Cambridge 42, Mass.—Folder describes the company's function in gathering and evaluating data regarding business problems for use by its clients in establishing correct policies.
For More Details Circle No. 101—Page 197

POWER TOOL JOURNAL: Power Tool Division, Rockwell Mfg. Co., 600 East Vienna Ave., Milwaukee 1—First issue of *Power Tool Journal*, which will be published six times

(*Concluded on page* 222)



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(*Concluded from page* 220)

yearly, details time and cost savings of three manufacturers in woodworking operations. Another article pictures and describes methods of shaper operation. Future issues will include information based on performance studies made of production, maintenance and experimental operations.

For More Details Circle No. 102—Page 197

CARBON BRIQUETS: United States Graphite Co., 1621 Holland St., Saginaw, Mich.—Illustrated folder describes graphitic carbon briquets for supplying a uniform steady source of graphitic carbon to cupola melts. Method of use, number of briquets required and general suggestions are discussed.

For More Details Circle No. 103—Page 197

SAND CONDITIONER: Jeffrey Mfg. Co., 907 North Fourth St., Columbus 16, O.—Illustrated bulletin 648 gives features and specifications of the company's sand conditioner. Suggested layout for a sand handling system incorporating the machine is included.

For More Details Circle No. 104—Page 197

ZIRCON PRODUCTS: Titanium Alloy Mfg. Division, National Lead Co., 111 Broadway, New York 6—Booklet describes zircon sand, flour, and mold and core wash. Tables of properties and suggested formulations are included.

For More Details Circle No. 105—Page 197

SAND ELEVATOR: Newaygo Engineering Co., State Rd., Newaygo, Mich.—Illustrated bulletin 205 describes an elevator for raising sand from the floor to one or two overhead hoppers serving one or two molding machines.

For More Details Circle No. 106—Page 197

CRANE BLOCK: American Hoist & Derrick Co., 63 South Robert St., St. Paul 1—Catalog 300-16 presents descriptive data and specifications on crane blocks designed with short overall length to permit maximum lifting clearance.

For More Details Circle No. 107—Page 197

VIBRATING EQUIPMENT: Robins Conveyors Division, Hewitt-Robins Inc., 270 Passaic Ave., Passaic, N. J.—Bulletins 134 and 135 illustrate and describe a vibrating feeder and vibrating conveyor, respectively.

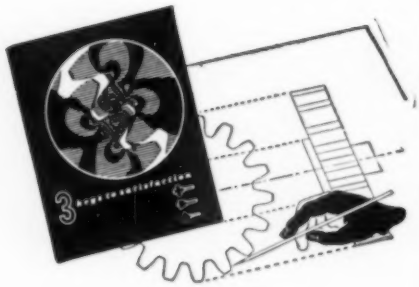
For More Details Circle No. 108—Page 197

SLIP JACKETS: Chicago Mfg. & Distributing Co., 1928 West 46th St., Chicago 9—New price list is offered on the company's compounded asbestos, nonburning, nonwarping slip jackets.

For More Details Circle No. 109—Page 197

SAFETY EQUIPMENT: Safety Clothing & Equipment Co., 7016 Euclid Ave., Cleveland 3—Catalog 501 lists the company's complete line of safety clothing and equipment. All items are illustrated.

For More Details Circle No. 110—Page 197



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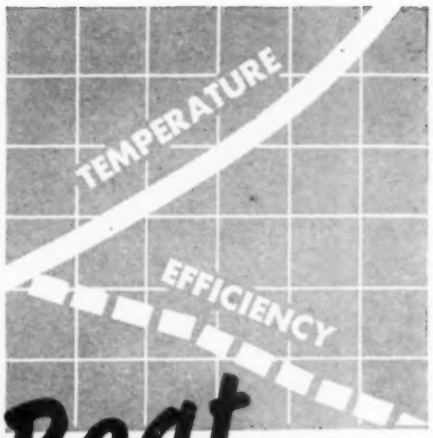

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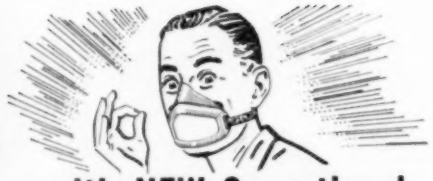

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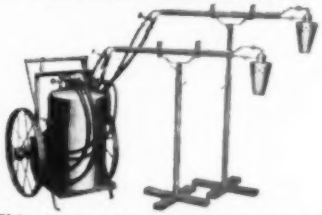

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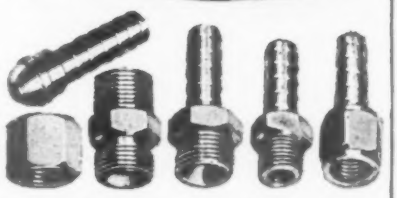

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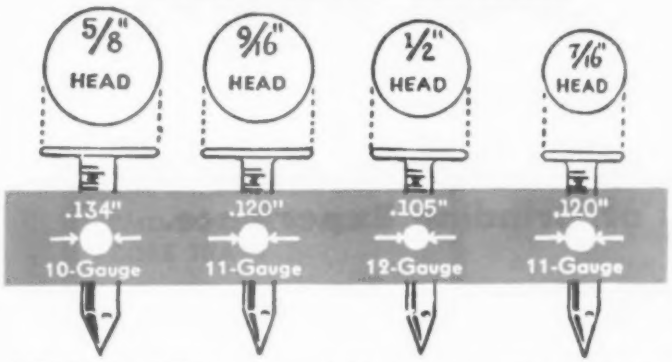
MULTIPLEX MACHINERY CORP. ELMORE OHIO

ANGELL . . . PROVEN PRESSURE PROOF CHAPLETS

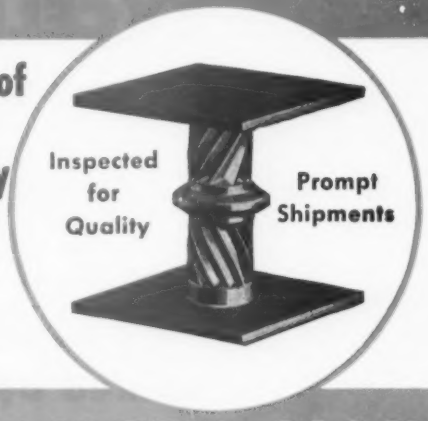
Producers of SUPER HEAD FOUNDRY NAILS



5/8", 9/16" & 1/2" Heads available up to 3 inches in length

Standard Foundry Nails available in all lengths.

All styles of Chaplets Accurately Made for Better Castings



THE ANGELL NAIL & Chaplet Company
4580 East 71st Street
CLEVELAND 5, OHIO

BLACKEN MOLDS
FASTER AND BETTER
with the
MURPHY PISTOL SPRAYER
ELIMINATES SWAB, BRUSH and SPRAY CAN

BLACKENING REACHES HIDDEN POCKETS
MOLDS ARE BLACKENED FASTER
CASTINGS PEEL BETTER
WORK COMES CLEANER
Satisfactory Performance Guaranteed or Money Back

PRICES COMPLETE WITH SUCTION HOSE AND SINKER

PIPE SIZE	1/16"	1/8"	1/4"	3/8"	1/2"
PRICE F. O. B. HAMILTON, O.	$12.00	$12.00	$12.00	$14.50	$18.00

Used for Silica wash, oil, water or any liquid material. For sand-blast cleaning. As a blow gun for cleaning motors and machinery. If your dealer cannot supply you at once, order direct from manufacturer below. Literature on request.

GUARANTEED CONDENSED AIR PRODUCTS

AFTERCOOLERS • SEPARATORS • STRAINERS • TRAPS
SPRAY GUNS • PISTOL SPRAYERS

JAS. A. MURPHY & CO.
FIFTH AND VINE STREETS HAMILTON, OHIO
Moisture Elimination Up To 3000 Pounds Per Square Inch

N & F BINS REDUCE HANDLING COST

This photograph shows a group of Neff & Fry Bins used in a coal handling operation. The coal is dumped into a pit, elevated to the bins, withdrawn by gravity. Manual labor is virtually eliminated. What's more, the material is kept off the ground and out of the weather.

N & F Bins, built of Super-Concrete Staves with encircling steel rods, have the stamina to withstand maximum stresses. The staves are formed under great hydraulic pressure, giving them rocklike density and high compression strength. Heavy superstructures are mounted upon the bins without extra supports.

Thousands of N & F Bins have remained intact for decades, used for handling and storing many kinds of flowable bulk materials—coal, grain, seeds, peanuts, minerals, chemicals, sand, wood chips, clay, etc.

Don't decide upon storage facilities before getting all the facts about N & F Super-Concrete Stave Bins. Ask for a copy of our catalog containing full information and numerous photographs of installations.

THE NEFF & FRY COMPANY
157 EAST CENTRAL AVENUE, CAMDEN, OHIO

NEFF & FRY STORAGE BINS

BLOOMSBURY GRAPHITE

home of the famous

EXCELLO PLUMBAGO BLACKING

offers a full line of Foundry Facings—

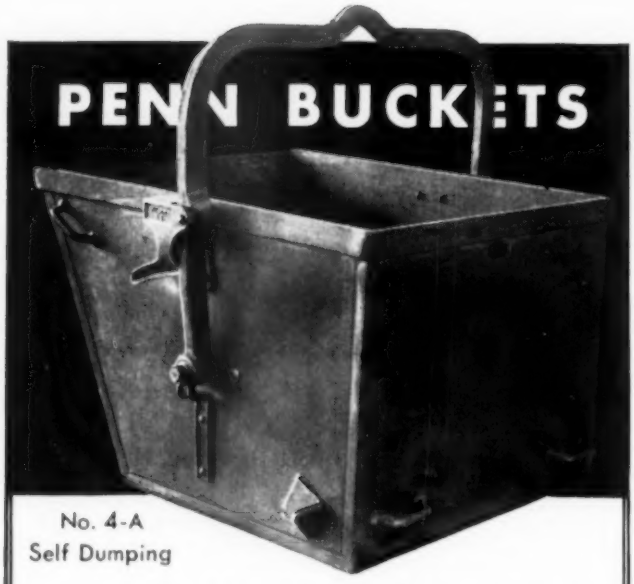
1. Blackings 2. Core Washes 3. Plumbagos 4. Pipe Eliminator

Here is the right product to meet all your Foundry Conditions—top-grade materials backed by 68 years of Grinding Experience.

Tell us your needs and we will send free samples to test.

BLOOMSBURY GRAPHITE COMPANY, SINCE 1882 BLOOMSBURY, N. J.

PENN BUCKETS



No. 4-A
Self Dumping

Careful balancing makes Penn Buckets self dumping when loaded and self righting when empty. Welded construction prevents "clinging" makes them empty easily and completely.

FOUNDRY EQUIPMENT MANUFACTURERS ASSOCIATION MEMBER FEMA

WRITE TODAY FOR NEW BULLETIN DIMENSION SHEET AND PRICE LIST

PENN IRON WORKS

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Master Power

HARD CHROMED • PORTABLE PNEUMATIC TOOLS

DO MORE WORK AT LESS COST

because they deliver more power per cubic foot of air consumed, are light in weight for easier maneuverability and they retain their new tool power longer.

ARE PREFERRED BY OPERATORS

because they are lighter in weight, better balanced and designed to reduce shock and be free from vibration.

IF YOUR PROBLEM INCLUDES

chipping, ramming, grinding, buffing, sanding or wire brushing, *write us today for full particulars.*

THE MASTER PNEUMATIC TOOL COMPANY, INC.

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SALES • SERVICE • STOCK • COAST TO COAST

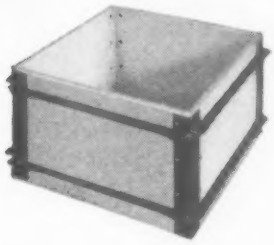
CMD FOUNDRY SPECIALTIES

CMD PNEUMATIC CORE BARROWS
With single or double wheels

CMD WOOD FLOOR FLASKS
All sizes and shapes

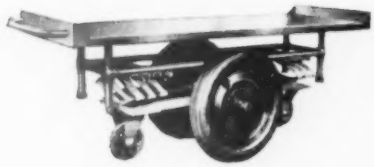
CMD DUAL-PURPOSE CORE TRAYS

TEXTITE AIR SEPARATOR
Cools, cleans and dries the air in one operation. *No moving parts.* Saves air tools. Nothing to replace.

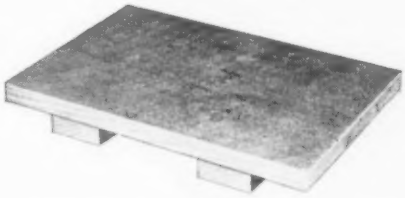


CMD NON-WARP, NON-BURN SLIP JACKETS

WRITE TODAY for free copy of illustrated catalog on CMD foundry equipment and specialties, including complete specifications and price lists.



CMD PNEUMATIC CORE TRUCKS
Minimize core chafing and breakage



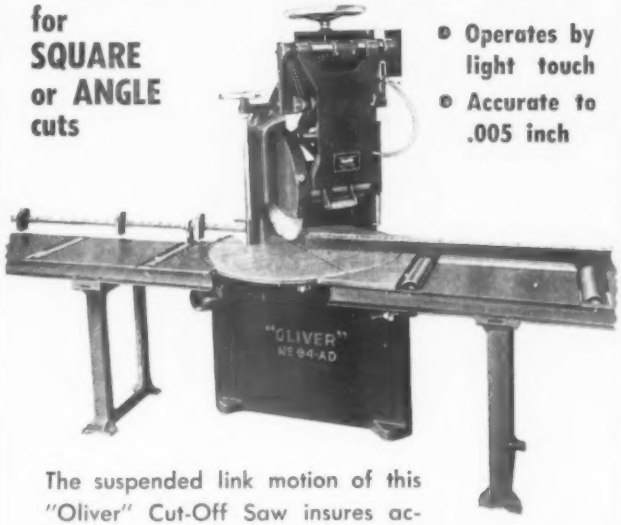
CMD WOOD BOTTOM BOARDS
All sizes and shapes

CHICAGO MANUFACTURING & DISTRIBUTING CO.
1928 West 46th Street • Chicago 9, Illinois

"Oliver" Cut-off Saw

for SQUARE or ANGLE cuts

- Operates by light touch
- Accurate to .005 inch

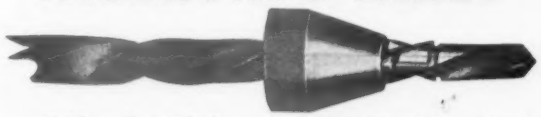


The suspended link motion of this "Oliver" Cut-Off Saw insures accurate, straight-line, easy operation. Saw returns to its original position without rebound. Machine swivels to make angle cuts 45° to right, 15° to left. Self-contained and compact. Saw table has automatic cut-off gauge and ball bearing steel rollers. *Write for Bulletin 94-AD.*

OLIVER MACHINERY COMPANY
GRAND RAPIDS 2, MICH.

SERVING YOU
in
"Core Blowing Operations"

INSERTING DRILL



• Uniformity of holes • Faster insertion of vent
• Correct Depth

CORE BOX VENTS

DEEP HEAD Wide or Narrow Slots .014 .010
SHALLOW HEAD Wide or Narrow Slots .014 .010
MESH .035

VENT CLEANER

for Cleaning Slots
Made of Tempered Steel, Easy to Use

C.M. SMILLIE & CO.

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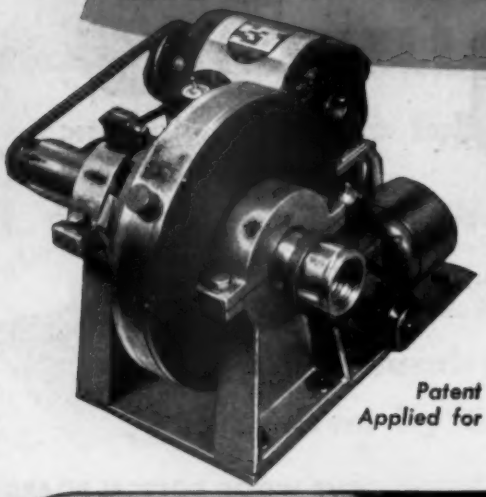
TOOLS • PRECISION MACHINED and GROUND PARTS • FIXTURES

NO MORE GUESSWORK . . .
MAKE YOUR OWN SHOT TESTS!



Patent Applied for

- This amazing new proving machine will give you accurate test of *any* blasting shot or grit.
- Actual blasting conditions are reproduced inside the machine which accurately measures the value of any blasting material and enables you to select the *right* shot or grit for your blasting job.
- Costly waste of "buy and try" is eliminated.
- Ask for a free demonstration in your *own* plant with your own shot or grit.

Developed by the makers of "AMASTEEL Trualloy", "PEENBLAST", "CLEANBLAST" and "ALLOY 99"

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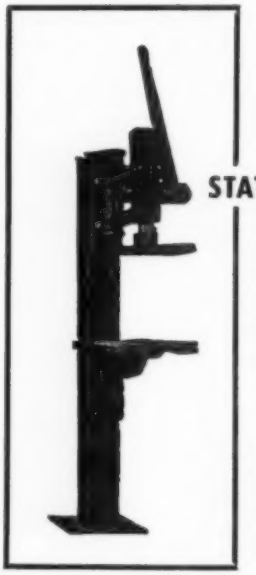
ALLOY METAL ABRASIVE CO.

311 WEST HURON ST. ANN ARBOR, MICH.



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STATIONARY MACHINE No. 11

For use in foundries where two or more heats are run per day and the floors are comparatively small. Head and table are adjustable in height. Handles flasks 12"x24" or under. Requires but 25 inches of floor space. Dimensions of table 12"x16". Dimensions of pressure plate 8"x12". Finished in quality aluminum enamel.

Moline Molding Machines are available in five models. Each is designed to deliver faster production, fewer rejects, a better profit. Write for catalog and prices.

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IRON WORKS
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ESTABLISHED 1878 • OVER SEVENTY YEARS OF SERVICE

THE BEST BUY IS WATERLOX
TRANSPARENT
Sealer and Impregnator for All Types and All Sizes of CASTINGS

Write the Manufacturer For Details

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A BLAST FURNACE PRODUCT

Smelted from Superior quality lake ores, high grade metallurgical coke and limestone, using our own local No. 1 Sharon Seam coal.

HIGH SILICON IRON JISCO

A "blend" with JISCO is sound metallurgy.

THE JACKSON IRON & STEEL *Company*
JACKSON, OHIO

No. 4 DAYTON RING VALVE BENCH RAMMER

MORE POWER—MORE SPEED

You'll get more production with these faster, more powerful rammers and at the same time substantially reduce maintenance costs.

The Valve Units will last for years. The Cylinder Bores and Piston Rods are HARD CHROME PLATED which doubles the life of the Rammer. Many of the largest foundries in the country have already adopted them as standard. Made in six sizes to meet every requirement.

Send for Bulletin 300

DAYTON PNEUMATIC TOOL CO.
Manufacturers of Pneumatic Tools Since 1903
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Use *Self-Dumping* Containers

MORE *Material Handling* — 50% *Less Time*

SIMPLE
SAFE
SPEEDY
MATERIAL
HANDLING

ROURA *Self- Dumping* HOPPERS

Only ROURA Has the Exclusive Instant Release (Patent Pending) Handle

Handling wet or dry, hot or cold, bulky materials quickly and easily, the ROURA is simple to operate—only one man is required for distributing and unloading—and he does this in much less time than ordinarily required under old-fashioned manual methods. Thousands of Roura Hoppers (which fit any standard fork or platform lift truck) are in constant daily operation, serving and saving for such firms as Owens-Illinois Glass, Corning Glass, National Fireproofing, General Motors, Ford, Chrysler, American Brake Shoe, General Electric, Westinghouse, Western Electric, American Steel Foundries, International Harvester, John Deere, etc.

By a simple lift of the exclusive release handle, the ROURA HOPPER dumps, rights and locks itself securely. Sizes — ½, ¾, 1, 1½ and 2 cubic yards; the ROURA HOPPER can also be designed for flat trucks and in other sizes to meet specifications. Also, it can be equipped with special flanges that permit stacking to desired tiers for storage or future distribution of materials — conserving valuable floor space. Priced below all competition, the ROURA will quickly pay for itself many times over.

Write today for detailed brochure.
"You Can Save 50% Labor-Time"

ROURA IRON WORKS, Inc.
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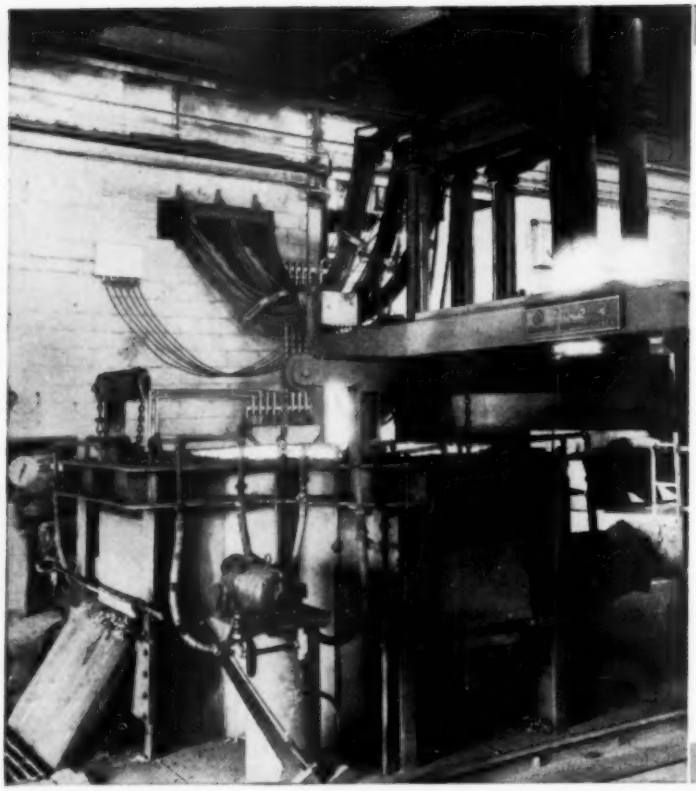

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. . . as ever, the dependable furnace for the production of high-grade stainless, alloy and rimming steels.

Precision-built, gear-driven mechanisms for maximum safety and dependability.

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General Offices: Frick Building, Pittsburgh, Pa.

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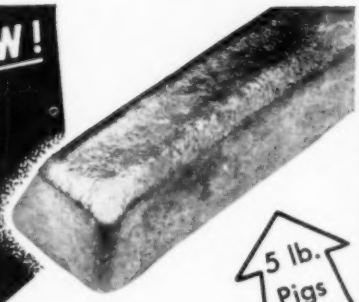
UNITED STATES STEEL

Available-NOW!

CASTING INGOTS of



5 lb. Pigs

BERYLLIUM COPPER

Just Melt and Pour

- Metallurgically controlled at mill.
- No fluxes or hardeners necessary.
- Can be remelted 2 to 3 times without sweetening.

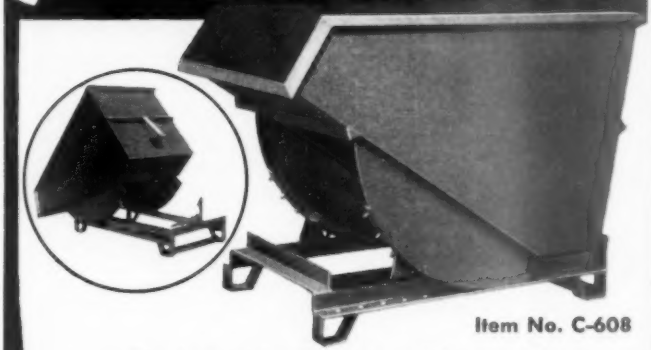
For complete information on casting methods, specific properties and applications, write to

BERYLLIUM

The BERYLLIUM CORPORATION
READING 8, PENNSYLVANIA

COMPLETE *NEW* DESIGN

P-S Automatic END DUMP
For Use With Lift Truck



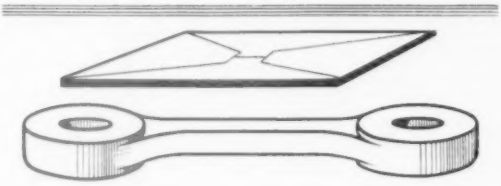
Item No. C-608

Speed up production, save man-hours with our new designed end dump, featuring simpler dumping by a smooth-operating rocker geared to track. Locks during loading by safety latch. Can be built for lift or fork truck or with casters that provide easy moving around machinery and through narrow aisles. Ideal for handling and dumping sand, castings, scrap, stampings and other heavy materials. Fits any fork or lift truck. All-welded construction. Built of heavy steel plate reinforced with heavy angles. Three standard sizes—½ yard, 1 yard and 1½ yards.

DESIGNED AND MANUFACTURED BY

Palmer-Shile Co.
16033 Fullerton Ave., DETROIT 27, MICH.

Gamma rays .....
unexposed film .....
steel casting .....

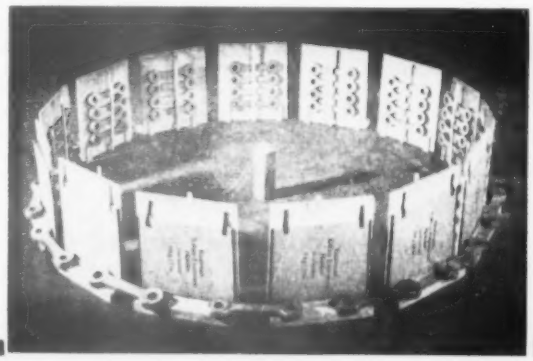


and there you have a method whereby you can increase your foundry production and improve your practice!

RADIUM RADIOGRAPHY

is new, compared with X-ray radiography, but its peculiar advantages have been finding increasing favor with steel foundries. The first commercial radiograph with radium was made in 1930—an exposure of the sternpost of the cruiser "Chester"—and by 1948 200 steel foundries throughout the country were using radium radiography. The equipment is absurdly simple, and, since it may be rented or leased, no capital expenditure is necessary. No special training is required to operate it, either. The constant activity of radium, the even dispersion of its rays with a minimum of scattering; the portability of the equipment and simplicity of operation all combine to make radium radiography a sound commercial proposition for manufacturers of steel castings. Write today for case histories and additional information.

Illustration shows 60 steel castings being photographed simultaneously. The gamma rays, flying in all directions, go through all the castings at once, making 60 exposures of the 60 castings.



RADIUM CHEMICAL CO., INC.

570 Lexington Ave., N. Y. 22, N. Y. Chicago: Marshall Field Annex Bldg.
3723 Wilshire Bldg., Los Angeles 5, Cal.

Patented Radiator Chaplet

Reduces Casting Rejects!

The **OPEN HEAD**

This exclusive design enables you to pack sand soundly under the head and around stem of chaplet. Cores are held rigidly, resulting in better castings. Seeing is believing—try it!

We also make MOTOR CHAPLETS, Boiler Chaplets, Forged Head Chaplets, Fitted Head Chaplets, Double Head Chaplets and other types.

CLEVELAND CHAPLET & MFG. CO.,
1197 West 67th Street
CLEVELAND, OHIO

CLEVELAND *Chaplets*
Since 1890

Where Production is the first Consideration, Pressure Cast Aluminum Matchplates and Cope and Drag Plates are the only Satisfactory Answer

Only one master pattern does it! From it we make you single or multiple pattern matchplates, casting them under pressure in plaster molds. Why not find out exactly how much we can save you by this method, or by furnishing cope and drag plates which likewise jump production and lower your costs?

Get our quotations today.

PLASTER PROCESS CASTINGS COMPANY
6922 Carnegie Avenue Cleveland 3, Ohio
(Toledo Matchplate Co., Toledo 2, Ohio, Affiliated)

Pressure-Cast MATCHPLATES
COPE and DRAG PLATES

For Surface Blemishes in ALUMINUM CASTINGS

Have you used the Smooth-On Foundry Cement made especially to correct blow holes, porous and rough spots, dents and other unsightly but harmless surface defects in otherwise sound *aluminum* alloy castings?

Applied like the widely used Smooth-On *Iron* Foundry Cement, Smooth-On No. 8 *Aluminum* Cement fills in evenly, hardens quickly, matches perfectly. Stays in place, too, for it expands slightly as it sets.

Smooth-On No. 8 Aluminum Cement comes in 1-and 5-lb. sizes. 1 lb. will fill 17 cu. in. Order it by NAME AND NUMBER from your supply house. If they haven't it, write us. If you have not yet discovered Smooth-On No. 8, ask us for

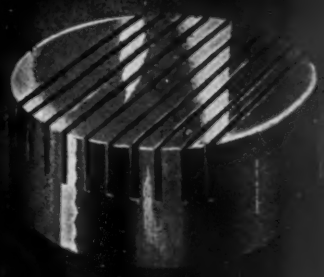
FREE SAMPLE TO TEST

You'll receive also the famous 40-page SMOOTH-ON HANDBOOK, filled with industrial uses for the various Smooth-On Cements. 170 illustrations. Write today.

SMOOTH-ON MFG. CO., Dept. 17
570 Communipaw Ave., Jersey City 4, N. J.

Do it with **SMOOTH-ON**
No. 8 ALUMINUM CEMENT

Precision



CORE BOX VENTS

Here's part of a complete line of DEMMLER core box vents—rigidly constructed in varying sizes of slotted brass—slotted steel—and screen mesh. Orders filled promptly from stock.

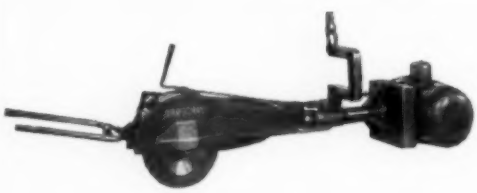
BRASS SLOTTED CORE BOX VENTS
Slot widths: .010", .013", .015"
Diameters: 1/8", 3/16", 1/4", 5/16", 3/8", 7/16", 1/2", 5/8", 3/4", 7/8", 1", 1 1/4", 1 1/2"

STEEL SLOTTED CORE BOX VENTS
Slot widths: .010", .013", .015"
Diameters: 1/8", 3/16", 1/4", 5/16", 3/8", 7/16", 1/2", 5/8", 3/4", 7/8", 1", 1 1/4", 1 1/2"

SCREEN TYPE CORE BOX VENTS
Mesh: #30, #40, #50.
Diameters: 1/8", 3/16", 1/4", 5/16", 3/8", 7/16", 1/2", 5/8", 3/4", 7/8", 1", 1 1/4", 1 1/2"

SPECIFICATION CIRCULAR ON REQUEST

Wm. **DEMMLER** *& Bros.*
Kewanee, Illinois



MARSCHKE SWING FRAMES ARE DIFFERENT!

Size for size, Marschke Swing Frame Grinders are *heavier* than any other machine on the market. This extra weight is no accident—it's there—in the right places—to eliminate *vibration*, the "wheel eater". Marschke swing frames give you better two-way balance . . . smoother spindle rotation: bearing seats are *precision ground and honed* to assure perfect spindle alignment and bearing fit.

These are only a few reasons why Marschke grinders are the best money can buy.

An inquiry will bring you interesting data.

VONNEGUT
MOULDER CORPORATION
1839 MADISON AVENUE • INDIANAPOLIS 25, INDIANA

ANALYSIS OF CASTING DEFECTS

133 pages, illustrated
Price $4.25 Postpaid

To help foundrymen minimize and eliminate defective castings. Thirty-one basic casting defects are listed and described. Defects are defined simply and completely, illustrated by 101 figures collected from foundries of the United States and Canada.

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Book Department
1213 W. 3rd St., Cleveland 13, Ohio

Carbon content determined in 2½ minutes with the

Leitz — BLOSJO

Carbonmeter

SPEED—Chill cast samples from molten steel analyzed electrically in only 2½ minutes.

SIMPLICITY—Sample bar is placed in Carbonmeter, reading is taken, reference is made to previously prepared calibration curve which indicates carbon content. This easy procedure enables the tender to do his own analyzing at the furnace.

VERSATILITY—Can be used with following melting practices:
Acid electric — Acid open hearth — Acid induction
Basic electric — Basic open hearth — Basic induction
Neutral induction—As a guide in re-carbonizing Bessemer steel

ACCURACY—Within ±0.2% carbon in the ranges of both unhardened and hardened steel.

RUGGED PORTABILITY—Designed to withstand shocks of normal handling without effect on accuracy. Self-contained power supply. Used in many of the world's greatest steel plants.

LOW PRICE—Despite its many advantages over comparable instruments, the Carbonmeter is available at a lower price.

For information, write **E. LEITZ, Inc.**, 304 Hudson Street, New York 13, N. Y.

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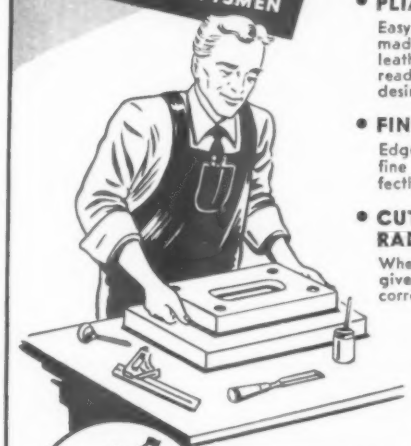
LEATHER FILLET

PREFERRED BY MASTER CRAFTSMEN



- **PLIABLE** Easy to work with because it's made of pure oak tanned leather which is soft and readily molded to position desired.
- **FINE FEATHER EDGE** Edges are feathered to a fine bevel edge to fit perfectly into your patterns.
- **CUT TO CORRECT RADIUS** When pressed into place, it gives you a radius that is correct in every detail.

FOR BETTER CASTINGS . . . BETTER PATTERNS . . . Write for samples and quotations. Immediate shipment from stock.

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Reduce Use of Chills in Gray Iron Casting

Now all you have to do to get hard chilled iron is add

TELLURIUM

Comes in 1, 2, 3 and 4-gram tablets; also in powder, slabs and sticks. For full information, write Dept. LM for 8-page article, "Use of TELLURIUM In Promoting Chills On Gray Iron Castings."

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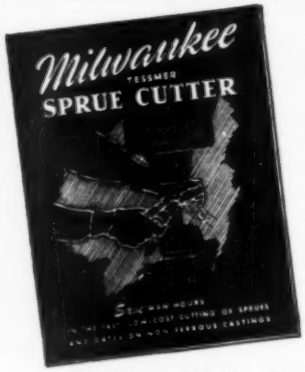

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Milwaukee Chaplet & Mfg. Co., 1023 So. 40th St., Milwaukee 4, Wis.
Standard Horse Nail Corp., New Brighton, Pa.

CHILL COATINGS

Acheson Colloids Corp., Port Huron, Mich.

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Shepard-Niles Crane & Hoist Corp., Montour Falls, N. Y.

HOISTS (Electric) (Cont'd.)

Whiting Corp., 15607 Lathrop Ave., Harvey, Ill.

HOISTS (Hand)

Chisholm-Moore Hoist Corp. and Columbus-McKinnon Chain Corp., Tonawanda, N. Y.
Cleveland Tramrail Div. of Cleveland Crane & Engineering Co., Wickliffe, Ohio.

HOISTS (Hydraulic)

Miller Motor Co., 4027 N. Kedzie, Chicago 18, Ill.

HOODS (Shakeout, pouring)

Claude B. Schneible Co., 2827 25th St., Detroit 16, Mich.

HOPPERS (Sand)

Industrial Fabricating, Inc., 817 Hall St., Eaton Rapids, Mich.

HOSE (Air, Blasting, Water, Gas)

Gardner-Denver Co., Quincy, Ill.
Hewitt Rubber Div. Hewitt-Robins Div., Inc., 240 Kinsington Ave., Buffalo 5, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Pangborn Corp., Hagerstown, Md.
Raybestos-Manhattan, Inc., Manhattan Rubber Div., Passaic, N. J.
Schramm Inc., West Chester, Pa.

HYDRAULIC CLEANING EQUIPMENT

Hydro-Blast Corp., 2050 N. Western Ave., Chicago 47, Ill.
Pangborn Corp., Hagerstown, Md.

HYDRO FINISHING EQUIPMENT

Pangborn Corp., Hagerstown, Md.

ILLUMINATORS (X-Ray Film)

Eastman Kodak Co., Rochester, N. Y.

IMPREGNATING SYSTEMS

Empire Varnish Co., 2636 E. 78th St., Cleveland 4, O.

INDUSTRIAL ENGINEERING SERVICE

Lester B. Knight & Associates, Inc., 600 West Jackson Blvd., Chicago 3, Ill.

INGOT MOLDS

Acme Foundry Co., Detroit 16, Mich.

INGOTS (Nonferrous)

Ajax Metal Co., Philadelphia 23, Pa.
Federated Metals Div. of American Smelting and Refining Co., 120 Broadway, New York 5
Apex Smelting Co., 2537 West Taylor St., Chicago 12, Ill.
Federated Metals Div., American Smelting and Ref. Co., New York 5
Frontier Bronze Corp., 818 Elmwood Ave., Niagara Falls, N. Y.
International Nickel Co., Inc., 67 Wall St., New York City 5
R. Lavin & Sons Inc., 3426 So. Kedzie Ave., Chicago 23, Ill.
Northwestern Iron & Metal Co., 900 "T" Street, Lincoln, Nebraska
Sonken-Galamba Corp., Kansas City 18, Kansas
Western Metals Co., 3201 So. Kedzie Ave., Chicago 23, Ill.

INJECTION MOLDING MACHINES

Lester-Phoenix Inc., 2711 Church St., Cleveland 13, Ohio
W. McGeough, Milwaukee 7, Wis.

INOCULANTS

Carborundum Co., Perth Amboy, N. J.
United States Graphite Co., Saginaw, Mich.

IRON CEMENT

Smooth-On Mfg. Co., 570 Communipaw Ave., Jersey City 4, N. J.

IRON ORE

Pickands, Mather & Co., Cleveland 14, O.

IRON OXIDES

Chicago Mfg. & Distributing Co., 1928 W. 46th St., Chicago 9, Ill.
Delta Oil Products Co., Milwaukee 9, Wis.
Tamms Industries Inc., 228 N. LaSalle St., Chicago 1, Ill.

JACKETS (Mold)

Adams Co., Dubuque, Iowa
Chicago Mfg. & Distributing Co., 1928 W. 46th St., Chicago 9, Ill.
Diamond Clamp & Flask Co., Richmond, Ind.
Fremont Flask Co., Fremont, O.
Hines Flask Co., 3431 W. 140th St., Cleveland 11, Ohio
Industrial Fabricating, Inc., 817 Hall St., Eaton Rapids, Mich.

LABORATORY EQUIPMENT (Chemical)

Harry W. Dietert Co., 9330A Roselawn Ave., Detroit 4, Mich.

LABORATORY EQUIPMENT (Physical)

Harry W. Dietert Co., 9330A Roselawn Ave., Detroit 4, Mich.
E. Leitz Inc., 730 Fifth Ave., New York 19, N. Y.
National Engineering Co., 549 W. Washington St., Chicago 6, Ill.
Norton Co., Worcester 6, Mass.

LADLES

Industrial Equipment Co., Minster, O.
Industrial Fabricating, Inc., 817 Hall St., Eaton Rapids, Mich.
Modern Equipment Co., Port Washington, Wis.
Frederic B. Stevens, Inc., Detroit 16, Mich.
Whiting Corp., 15607 Lathrop Ave., Harvey, Ill.

LADLE LININGS

A. P. Green Fire Brick Co., Mexico, Missouri
Harbison-Walker Refractories Co., 1745 Farmers Bank Bldg., Pittsburgh 22, Pa.
Ironton Fire Brick Co., Ironton, Ohio
United States Graphite Co., Saginaw, Mich.

LEAD

Federated Metals Div., American Smelting and Refining Co., 120 Broadway, New York 5.

LINSEED OIL

Hercules Powder Co., Wilmington 99, Del.

LOADERS

Clearfield Machine Co., Clearfield, Pa.
National Engineering Co., 549 W. Washington St., Chicago 6, Ill.

LOADERS (Tractor-Mounted)

Frank G. Hough Co., Libertyville, Ill.

LUBRICANTS (Industrial)

Acheson Colloids Corp., Port Huron, Mich.
Smith Oil & Refining Co., 1102 Kilburn Ave., Rockford, Ill.
United States Graphite Co., Saginaw, Mich.

MACHINE KEYS

Standard Horse Nail Corp., New Brighton, Pa.

MAGNESIUM (Ingots)

Apex Smelting Co., 2537 West Taylor St., Chicago 12, Ill.
Federated Metals Division of American Smelting and Refining Co., 120 Broadway, New York 5, N. Y.

MAGNET CONTROLLERS

Ohio Electric Mfg. Co., 5906 Maurice Ave., Cleveland, Ohio

MAGNETS

Dings Magnetic Separator Co., 4740 Electric Ave., Milwaukee 7, Wis.
Ohio Electric Mfg. Co., 5906 Maurice Ave., Cleveland, Ohio.
Stearns Magnetic Mfg. Co., 662 S. 28th St., Milwaukee 4, Wis.

MANGANESE (Briquets)

Electro Metallurgical Div. Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.

MATCH PLATE METAL

Federated Metals Division of American Smelting and Refining Co., 120 Broadway, New York 5, N. Y.

MATCHPLATES

Accurate Match Plate Co., 1847 W. Carroll St., Chicago, Ill.
Central Pattern Co., Quincy, Ill.
Champion Foundry & Machine Co., 1553 W. Madison St., Chicago 7, Ill.
City Pattern Foundry & Machine Co., 1161 Harper Ave., Detroit 11, Mich.
Hines Flask Co., 3431 W. 140th St., Cleveland 11, Ohio.
Industrial Pattern Works, 2625 West Belmont Ave., Chicago 18, Ill.
Plaster Process Castings Co., 6922 Carnegie Ave., Cleveland 3, O.
Scientific Cast Products Corp., 1388-92 E. 40th St., Cleveland 3, O.
Arthur E. Will, 643 West 11th St., Erie, Pa.

MATERIALS HANDLING EQUIPT.

Frank G. Hough Co., Libertyville, Ill.

MATERIALS HANDLING DESIGN

Frank D. Campbell, 332 So. Michigan Ave., Chicago, Ill.

MATERIALS HANDLING (Hoists)

Chisholm-Moore Hoist Corp. and Columbus-McKinnon Chain Corp., Tonawanda, N. Y.

MECHANICAL ENGINEERS

Frank D. Campbell, 332 So. Michigan Ave., Chicago, Ill.
Giffels & Vallet, Inc., Marquette Bldg., Detroit, Mich.

MELTING POTS

Acme Foundry Co., Detroit 16, Mich.

METAL CLEANING EQUIPMENT

American Wheelabrator & Equipment Co., Mishawaka, Ind.

Pangborn Corp., Hagerstown, Md.

METALLOGRAPHIC EQUIPMENT

Harry W. Dietert Co., 9330A Roselawn Ave., Detroit 4, Mich.

General Electric X-Ray Corp., 4855 Electric Ave., Milwaukee 14, Wis.

METALLURGISTS

Crobaugh Co., Frank L., 1426 West Third St., Cleveland 13, Ohio.

METERS (Gas, Air, Water)

Illinois Testing Laboratories, Inc., 418 N. LaSalle St., Chicago 10, Ill.

Roots-Connersville Blower Corp., Connersville, Ind

MIXERS (Core Wash)

Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.

Multiplex Machinery Corp., Elmore, Ohio.

MIXERS (Sand and Clay)

American Wheelabrator & Equipment Co., 505 S. Byrkit St., Mishawaka, Ind.

Beardsley & Piper Co., The, 2424 No. Cicero, Chicago 39, Ill. St., Chicago 6, Ill.

Clearfield Machine Co., Clearfield, Pa.

Construction Machinery Co., Waterloo, Iowa.

Fordath Engineering Co. Ltd., West Bromwich, Birmingham, England.

Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, Ohio

Jeffrey Mfg. Co., 907 N. Fourth St., Columbus 16, O.

Multiplex Machinery Corp., Elmore, Ohio

National Engineering Co., 549 W. Washington St., Chicago 6, Ill.

Posey Iron Works Inc., Lancaster, Pa.

Royer Foundry & Machine Co., Kingston, Pa.

MOLD CONVEYORS

Bartlett & Snow, C. O., Co., 6201 Harvard Ave., Cleveland 5, O.

Beardsley & Piper Co., The, 2424 No. Cicero, Chicago 39, Ill.

Cleveland Tramrail Div. of Cleveland Crane & Engineering Co., Wickliffe, Ohio.

Jeffrey Mfg. Co., 907-99 N. Fourth St., Columbus 16, O.

Link-Belt Co., 300 W. Persning Rd., Chicago 9, Ill.

Logan Co., 580 Cabel, Louisville, Ky.

Mathews Conveyer Co., Ellwood City, Pa.

National Engineering Co., 549 W. Washington St., Chicago 6, Ill.

Newaygo Engineering Co., Newaygo, Mich.

MOLD COOLING HOODS

Claude B. Schneible Co., 2827 25th St., Detroit 16, Mich.

MOLD DRYERS

Carl-Mayer Corp., 3030 Euclid Ave., Cleveland 15, Ohio.

Foundry Equipment Co., 1831 Columbus Rd., Cleveland 13, Ohio.

MOLD OVENS and DRYERS

Carl-Mayer Corp., 3030 Euclid Ave., Cleveland 15, Ohio.

Despatch Oven Co., Minneapolis 14, Minn.

Drying Systems, Inc., 1801 Foster Ave., Chicago 40, Ill.

Foundry Equipment Co., 1831 Columbus Rd., Cleveland 13, O.

Lanly Company, 750 Prospect Ave., Cleveland 15, O.

Ross Engineering Corp., J. O., 350 Madison Ave, New York 17, N. Y.

MOLD TRUCKS (Power Operated)

Clark Industrial Truck Div., Clark Equipment Co., Battle Creek, Mich.

MOLD WASH

Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.

National Carbon Co., Inc., Carbon Products Div., 30 E. 42nd St., New York 17, N. Y.

Frederic B. Stevens, Inc., 18th St. & Vernor Highway, Detroit 16, Mich.

United States Graphite Co., Saginaw, Mich.

MOLDING MACHINES

Adams Co., Dubuque, Iowa.

Beardsley & Piper Co., The, 2424 N. Cicero, Chicago 29, Ill.

British Moulding Machine Co., Faverham, Kent, England

Champion Foundry & Machine Co., 1553 W. Madison St., Chicago 7, Ill.

Davenport Machine & Foundry Co., Davenport, Iowa.

Herman Pneumatic Machine Co., Union Bank Bldg., Pittsburgh 22, Pa.

International Molding Machine Co., LaGrange Park, Ill.

Johnston & Jennings Div., Pettibone-Mulliken Corp., 2424 No. Cicero Ave., Chicago 39, Ill.

Milwaukee Foundry Equipment Div. Spo Inc., 3238 W. Pierce St., Milwaukee 4, Wis.

Moline Iron Works, Moline, Ill.

Nichols, Wm. H., Co., Richmond Hill, Long Island 18, N. Y.

Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland 14, O.

S. P. O. Incorporated, 7500 Grand Division Ave., Cleveland 5, O.

Stone-Wallwork Ltd., 157 Victoria St., London, England.

Tabor Mfg. Co., 6225 Tacony St., Philadelphia 35, Pa.

MOLDING MACHINES (Jolt)

Adams Co., Dubuque, Iowa.

Champion Foundry & Machine Co., 1553 West Madison St., Chicago 7, Ill.

Davenport Machine & Foundry Co., Davenport, Iowa.

Herman Pneumatic Machine Co., Union Bank Bldg., Pittsburgh 22, Pa.

International Molding Machine Co., LaGrange Park, Ill.

Johnston & Jennings Div., Pettibone-Mulliken Corp., 2424 No. Cicero Ave., Chicago 39, Ill.

Milwaukee Foundry Equipment Div., Spo Inc., 3328 Pierce St., Milwaukee 4, Wis.

Nicholls, Wm. H., Co., Richmond Hill, Long Island 18, N. Y.

Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland 14, O.

S. P. O. Incorporated, 7500 Grand Division Ave., Cleveland 5 O.

Stone-Wallwork Ltd., 157 Victoria St., London, England.

Tabor Mfg. Co., 6225 Tacony St. Philadelphia 35, Pa.

MOLDING MACHINES (Rollover)

Champion Foundry & Machine Co., 1553 W. Madison St., Chicago 7, Ill.

Davenport Machine & Foundry Co., Davenport, Iowa.

MOLDING MACHINES (Rollover) (Cont'd.)

Herman Pneumatic Machine Co., Union Bank Bldg., Pittsburgh 22, Pa.

International Molding Machine Co., LaGrange Park, Ill.

Johnston & Jennings Div., Pettibone-Mulliken Corp., 2424 No. Cicero Ave., Chicago 39, Ill.

Milwaukee Foundry Equipment Div., Spo Inc., 3328 Pierce St., Milwaukee 4, Wis.

Nicholls, Wm. H., Co., Richmond Hill, Long Island 18, N. Y.

Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland 14, O.

S. P. O. Incorporated, 7500 Grand Division Ave., Cleveland 5 O.

Tabor Mfg. Co., 6225 Tacony St., Philadelphia 35, Pa.

MOLDING MACHINES (Squeeze)

Adams Co., Dubuque, Iowa.

Champion Foundry & Machine Co., 1553 W. Madison St., Chicago 7, Ill.

Davenport Machine & Foundry Co., Davenport, Iowa.

Herman Pneumatic Machine Co., Union Bank Bldg., Pittsburgh 22, Pa.

International Molding Machine Co., LaGrange Park, Ill.

Johnston & Jennings Div., Pettibone-Mulliken Corp., 2424 No. Cicero Ave., Chicago 39, Ill.

Milwaukee Foundry Equipment Div., Spo Inc., 3328 Pierce St., Milwaukee 4, Wis.

Moline Iron Works, Moline, Ill.

Nicholls, Wm. H., Co., Richmond Hill, Long Island 18, N. Y.

Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland 14, Ohio.

S. P. O. Incorporated, 7500 Grand Division Ave., Cleveland 5, O.

Stone-Wallwork Ltd., 157 Victoria St., London, England.

Tabor Mfg. Co., 6225 Tacony St., Philadelphia 35, Pa.

MOLDING SANDS

American Silica Sand Co., Central Life Bldg., Ottawa, Ill.

Ottawa Silica Co., Ottawa, Ill.

Standard Silica Corp., 209 So. LaSalle St., Chicago 4, Ill.

Wedron Silica Co., 38 So. Dearborn St., Chicago, Ill.

MOLYBDENUM

Molybdenum Corporation of America, Pittsburgh 19, Pa.

MONOGRAMS & TRADEMARKS

H. P. Maughlin Co., 953 Ingleside Ave., Columbus, Ohio.

MONORAIL SYSTEMS

American Monorail Co., 13104 Athens Ave., Cleveland 7, O.

Cleveland Tramrail Div. of Cleveland Crane & Engineering Co., 1155 East 283rd St., Wickliffe, O.

Link-Belt Co., 300 W. Pershing Rd., Chicago 9, Ill.

Modern Equipment Co., Port Washington, Wis.

MOTORS (Electric)

Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.

Ohio Electric Mfg. Co., 5906 Maurice Ave., Cleveland, Ohio.

NAILS (Chill)

Angell Nail & Chaplet Co., 4580 E. 71st St., Cleveland 5, O.

Crescent Brass & Pin Co., 5766 Trumbull Ave., Detroit, Mich.

Republic Steel Corp., 3100 E. 45th St., Cleveland 4, Ohio.

Standard Horse Nail Corp., New Brighton, Pa.

NICKEL

International Nickel Co., Inc., 67 Wall St., New York City 5.

NITROGEN

Air Reduction Sales Co., 60 East 42nd St., New York 17, N. Y.

Linde Air Products Co., 30 E. 42nd St., New York 17, N. Y.

NOZZLES (Blasting)

Alloy Metal Abrasives Co., 311 W. Huron St., Ann Arbor, Mich.

American Wheelabrator & Equipment Co., 505 S. Byrkit St., Mishawaka, Ind.

Davenport Machine & Foundry Co., Davenport, Iowa.

Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.

Norton Co., Worcester 6, Mass.

Pangborn Corp., Hagerstown, Md.

OIL BURNERS

Hauck Manufacturing Co., 106 Tenth St., Brooklyn 15, N.Y.

Lindberg Engineering Co., Fisher Furnace Div., 2450 West Hubbard, Chicago 12, Ill.

Stroman Furnace & Engineering Co., Div. of Peterson Oven Co., 9900 Franklin Ave., Franklin Park, Ill.

OVENS (Annealing and Heat Treating)

Carl-Mayer Corp., 3030 Euclid Ave., Cleveland 15, Ohio.

Despatch Oven Co., Minneapolis 14, Minn.

Electric Furnace Co., Salem, Ohio.

Foundry Equipment Co., 1831 Columbus Rd., Cleveland 13, Ohio.

Lanly Company, 750 Prospect Ave., Cleveland 15, O.

Lindberg Engineering Co., Fisher Furnaces Div., 2450 West Hubbard, Chicago 12, Ill.

Whiting Corp., 15607 Lathrop Ave., Harvey, Ill.

OVENS (Core) (See CORE OVENS)

OVENS (Enameling, Japanning)

Carl-Mayer Corp., 3030 Euclid Ave., Cleveland 15, Ohio.

Despatch Oven Co., Minneapolis 14, Minn.

Foundry Equipment Co., 1831 Columbus Rd., Cleveland 13, Ohio.

Lanly Co., 750 Prospect Ave., Cleveland 15, Ohio.

OVENS (Mold)

Carl-Mayer Corp., 3030 Euclid Ave., Cleveland 15, Ohio.

Despatch Oven Co., Minneapolis 14, Minn.

Foundry Equipment Co., 1831 Columbus Rd., Cleveland 13, Ohio.

Lanly Co., 750 Prospect Ave., Cleveland 15, Ohio.

OXYGEN

Air Reduction Sales Co., 60 East 42nd St., New York 17, N. Y.

Linde Air Products Co., 30 E. 42nd St., New York 17, N. Y.

PARTING COMPOUNDS

Delta Oil Products Co., Milwaukee 9, Wis.

Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.

E. F. Houghton Co., 303 W. Lehigh Ave., Philadelphia 33, Pa.

Smith Oil & Refining Co., 1102 Kilburn Ave., Rockford, Ill.

PARTING COMPOUNDS (Cont'd.)

Frederic B. Stevens, Inc., Detroit 16, Mich.
Tamms Industries Inc., 228 N. LaSalle St., Chicago 1, Ill.

PATTERN COATINGS

American Lacquer Solvents Co., Phoenixville, Pa.

PATTERN COMPOUND

Tamms Industries Inc., 228 N. LaSalle St., Chicago 1, Ill.

PATTERN LETTERS

Freeman Supply Co., 1152 East Broadway, Toledo, Ohio.
H. P. Maughlin Co., 953 Ingleside Ave., Columbus, Ohio

PATTERN LUMBER

Dougherty Lumber Co., Cleveland 5, O.
Freeman Supply Co., 1152 East Broadway, Toledo, Ohio.
Rietz Lumber Co., 1800 N. Central Park Ave., Chicago, Ill.

PATTERN METAL

Federated Metals Division of American Smelting and Refining Co., 120 Broadway, New York 5, N. Y.
Niagara Falls Smelting & Refining Div., Continental-United Industries Co. Inc., 2204 Elmwood Ave., Buffalo 17, New York.

PATTERN PLATES

Accurate Match Plate Co., 1847 W. Carroll St., Chicago, Ill.
Buffalo Pattern Works, 830 Hertel Ave., Buffalo, N. Y.
Central Pattern Co., Quincy, Ill.
City Pattern Foundry & Machine Co., 1161 Harper Ave., Detroit 11, Mich.
Freeman Supply Co., 1152 East Broadway, Toledo, Ohio.
Hines Flask Co., 3431 W. 140th St., Cleveland 11, Ohio.
Industrial Pattern Works, 2625 West Belmont Ave., Chicago 18, Ill.
Plaster Process Castings Co. 6922 Carnegie Ave., Cleveland 3.
Scientific Cast Products Corp., 1388-92 E. 40th St., Cleveland 3, O
Arthur E. Will, 643 West 11th St., Erie, Pa.

PATTERN SHOP EQUIPMENT

Do All Company, Des Plaines, Ill.
Freeman Supply Co., 1152 East Broadway, Toledo, Ohio.
Milwaukee Leather Belting Co., 1114 No. Water St., Milwaukee, Wis.
Oliver Machinery Company, Grand Rapids 2, Mich.

PATTERNS

Industrial Pattern Works, 2625 West Belmont Ave., Chicago 18, Ill.

PATTERNS (PLASTIC)

Central Pattern Co., Quincy, Ill.

PATTERNS (Wood, Metal)

Accurate Match Plate Co., 1847 W. Carroll St., Chicago, Ill.
Buffalo Pattern Works, 830 Hertel Ave., Buffalo, N. Y.
Central Pattern Co., Quincy, Ill.
Champion Foundry & Machine Co., 1553 W. Madison St., Chicago 7, Ill.
City Pattern Foundry & Machine Co., 1161 Harper Ave., Detroit 11, Mich.

PATTERNS (Wood, Metal) (Cont'd.)

Hines Flask Co., 3431 W. 140th St., Cleveland 11, Ohio
Industrial Pattern Works, 2625 West Belmont Ave., Chicago 18, Ill.
S. P. O. Incorporated, 7500 Grand Division Ave., Cleveland 5, O.
Wellman Bronze & Aluminum Co., 2525 E. 93rd St., Cleveland 4, O.
Arthur E. Will, 643 West 11th St., Erie, Pa.

PERMANENT MOLDS

Centrifugal Casting Machine Co., Tulsa, Okla.
Reserve Machine & Tool Co., 10026 Detroit Ave., Cleveland, Ohio.

PHOSPHOR COPPER

Federated Metals Division of American Smelting and Refining Co., 120 Broadway, New York 5, N. Y.
Niagara Falls Smelting & Refining Div. Continental-United Industries Co. Inc., 2204 Elmwood Ave., Buffalo 17, N. Y.

PHOTOGRAPHIC EQUIPMENT

Eastman Kodak Co., Rochester, N. Y.
General Electric X-Ray Corp., 4855 Electric Ave., Milwaukee 14, Wis.

PHOTOGRAPHY (Industrial)

Eastman Kodak Co., Rochester, N. Y.

PIG IRON

Hickman-Williams & Co., Union Commerce Bldg., Cleveland 14, O.
Inland Steel Co., 38 So. Dearborn St., Chicago 3, Ill.
Jackson Iron & Steel Co., Jackson, Ohio.
Keokuk Electro Metals Co., 429 So. 4th St., Keokuk, Iowa.
Miller & Company, 332 S. Michigan Ave., Chicago 4, Ill.
Pickands, Mather & Co., Cleveland 14, O.
Republic Steel Corp., 3100 E. 45th St., Cleveland 4, Ohio.
Tennessee Products & Chemical Corp., American National Bank Bldg., Nashville 3, Tenn.
Woodward Iron Co., Woodward, Ala.

PIG IRON (Silvery)

Jackson Iron & Steel Co., Jackson, O.
Keokuk Electro Metals Co., 429 So. 4th St., Keokuk, Iowa.
Miller & Company, 332 S. Michigan Ave., Chicago 4, Ill.

PINS (Flask)

Hines Flask Co., 3431 W. 140th St., Cleveland 11, Ohio.
Shanafelt Mfg. Co., 3623 Winfield Way, N.E., Canton 5, Ohio.
Sterling Wheelbarrow Co., 7100 W. Walker St., Milwaukee 14, Wis.
Truscon Steel Co., Pressed Steel Div., 6100 Truscon Ave., Cleveland, Ohio.
Universal Engineering Co., Frankenmuth, Mich.

PISTON RINGS (for Molding Machines, Compressors, etc.)

Nicholls, Wm. H., Co., Richmond Hill, Long Island 18, N. Y.

PLANT ENGINEERING SERVICE

H. K. Ferguson, 1783 E. 11th St., Cleveland 14, Ohio.
Giffels & Vallet, Inc., Marquette Bldg., Detroit, Mich.
Lester B. Knight & Associates, Inc., 600 West Jackson Blvd., Chicago 3, Ill.

PLATES (Bottom)

Adams Co., Dubuque, Iowa.
Sterling Wheelbarrow Co., 7100 W. Walker St., Milwaukee 14, Wis.

PLATES (Core Drying)

Champion Foundry & Machine Co., 1553 W. Madison St., Chicago 7, Ill.
Johns-Manville, 22 East 40th St., New York 16.

PLATING TEMPERATURE CONTROLS

Foxboro Company, Foxboro, Mass.

PLUMBAGO

Bloomsbury Graphite Co., Bloomsbury, N. J.
Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.
Frederic B. Stevens, Inc., Detroit 16, Mich.
United States Graphite Co., Saginaw, Mich.

PNEUMATIC TOOLS

Chicago Pneumatic Tool Co., 6 East 44th St., New York 17, N. Y.
Cleco Pneumatic Tool Div., Reed Roller Bit Co., Houston, Texas.
Dayton Pneumatic Tool Co., Dayton 1, Ohio.
Gardner-Denver Co., Quincy, Ill.
Independent Pneumatic Tool Co., Aurora, Ill.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Joy Mfg. Co., Sullivan Division, Michigan City, Ind.
Master Pneumatic Tool Co., Inc., Orwell, Ohio.
Rotor Tool Co., 17225 Euclid Ave., Cleveland 12, Ohio.
Schramm Inc., West Chester, Pa.

POURING DEVICES

Industrial Equipment Co., Minster, Ohio.
Modern Equipment Co., Port Washington, Wis.
Whiting Corp., 15607 Lathrop Ave., Harvey, Ill.

PRESSER BOARDS

Adams Co., Dubuque, Iowa.
Chicago Mfg. & Distributing Co., 1928 W. 46th St., Chicago 9, Ill.

PRESSURE CASTING SEALER

Empire Varnish Co., 2636 E. 76th St., Cleveland 4, O.

PRESSURE RECORDERS

Foxboro Company, Foxboro, Mass.

PROTECTIVE MATERIALS (X-Ray)

General Electric X-Ray Corp., 4855 Electric Ave., Milwaukee 14, Wis.

PULLEYS (Magnetic)

Dings Magnetic Separator Co., 4740 Electric Ave., Milwaukee 7, Wis.
Stearns Magnetic Mfg. Co., 662 S. 28th St., Milwaukee 4, Wis.

PUMPS

Construction Machinery Co., Waterloo, Iowa.
Gardner-Denver Co., Quincy, Ill.
Claude B. Schneible Co., 2827 25th St., Detroit 16, Mich.

PUMPS (Dry, Vacuum)

Allis Chalmers Mfg. Co., Milwaukee 1, Wis.
Fuller Company, Catasauqua, Pa.
Roots-Connersville Blower Corp., Connersville, Ind.

PURIFIERS

Cleveland Flux Co., 1026 Main St., Cleveland 13, O.

PUSH-OFF MACHINES

Beardsley & Piper Co., 2424 N. Cicero, Chicago 39, Ill.
Champion Foundry & Machine Co., 1553 W. Madison St., Chicago 7, Ill.
International Molding Machine Co., LaGrange Park, Ill
Milwaukee Foundry Equipment Div. Spo Inc., 3238 W. Pierce St., Milwaukee 4, Wis.

PUTTY (Foundry)

Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.

PYROMETERS

Foxboro Company, Foxboro, Mass.
Harry W. Dietert Co., 9330A Roselawn Ave., Detroit 4, Mich.
Claude S. Gordon Co., 3000 So. Wallace, Chicago 16, Ill.
Illinois Testing Laboratories, Inc., 418 N. LaSalle St., Chicago 10, Ill.
Marshall Co., L. H., 270 W. Lane, Columbus 1, O.
Pyrometer Instrument Co., Bergenfield, N. J.
Tamms Industries Inc., 228 N. LaSalle St., Chicago 1, Ill.

PYROMETERS (Immersion)

Pyrometer Instrument Co., Bergenfield, N. J.

PYROMETERS (Optical)

Pyrometer Instrument Co., Bergenfield, N. J.

RACKS (Core Ovens)

Foundry Equipment Co., 1845 Columbus Rd., Cleveland 13, Ohio

RADIOGRAPHY (Industrial)

Eastman Kodak Co., Rochester, N. Y.
Eldorado Mining & Refining Ltd., P. O. Box 379, Ottawa, Ont.
Radium Chemical Co., Inc., 570 Lexington Ave., New York 22, N. Y.

RADIUM

Eldorado Mining & Refining Ltd., P. O. Box 379, Ottawa, Ont.
Radium Chemical Co., Inc., 570 Lexington Ave., New York 22, N. Y.

REFRACTORIES

Babcock & Wilcox Co., 85 Liberty St., New York 6, N. Y.
Carborundum Co., Niagara Falls, N. Y.
Carborundum Co., Perth Amboy, N. J.
Cleveland Quarries Co., 1740 E. 12th St., Cleveland 14, O.
Eastern Clay Products, Inc., Jackson, O.
Electro Refractories & Alloys Corp., Vars Bldg., Buffalo 2, N. Y.

REFRACTORIES (Cont'd.)

A. P. Green Fire Brick Co., Mexico, Missouri

Harbison-Walker Refractories Co., 1745 Farmers Bank Bldg., Pittsburgh 22, Pa.

Ironton Fire Brick Co., Ironton, O.

Lindberg Engineering Co., Fisher Furnace Div., 2450 West Hubbard, Chicago 12, Ill.

Mexico Refractories Co., Mexico, Mo.

Norton Co., Worcester 6, Mass.

Frederic B. Stevens, Inc., 18th St. & Vernor Highway, Detroit 16, Mich.

Chas. Taylor Sons Co., P.O. Box 58, Annex Sta., Cincinnati 14, Ohio

United States Graphite Co., Saginaw, Mich.

RESPIRATORS

Goggle Parts Company Inc., 1468 West 9th St., Cleveland 13, Ohio

Wilson Products Inc., Reading, Pa.

RIDDLES

Frederic B. Stevens, Inc., 18th St. & Vernor Highway, Detroit 16, Mich.

RIDDLES (Electric)

Champion Foundry & Machine Co., 1553 W. Madison St., Chicago 7, Ill.

Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.

Foundry Supplies & Mfg. Co., 2221 Orchard St., Chicago 14, Ill.

Great Western Mfg. Co., Leavenworth, Kans.,

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Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.
General Electric X-Ray Corp., 4855 Electric Ave., Milwaukee 14, Wis.

X-RAY FILMS

Eastman Kodak Co., Rochester, N. Y.
General Electric X-Ray Corp., 4855 Electric Ave., Milwaukee 14, Wis.

ZINC

Federated Metals Div. American Smelting and Refining Co., 120 Broadway, New York 5, N. Y.

Classified Advertising

For Sale

FOR SALE

1—#4 Whiting Cupola W/new 2700 C.F.M. "North American Turbo-type Blower, 220-440V, 3 ph. 60 cy.
1—Whiting Elevator 1 ton cap. 20' lift (air operated)
1—Sly Sandblast room Type "F", size 8' x 8' x 10' with exhaust fan, bucket, hoist & dust collector.
1—Wardwell Saw filing machine & Saw set. Like new.
1—Lanly Recirculating type oven. Completely automatic, oil fired. Max. temperature 500°. Size 9'4" x 6'6" x 8'6" high.
6—Campbell-Hausfeld #200 Stationary Magnesium Melting furnaces.
1—Sklenar Reverbatory type furnace, oil fired. 1 ton capacity w/air ram, blower, 220 V, s ph. 60 cy.
4—Pit-type furnaces. Fisher burners. Oil fired, #250 crucible size.
1—Air Compressor, Gardner-Denver horizontal. Size 10 x 10. W/motor G.E. 40 hp., 200 V., 3 ph. 60 cy.
1—Wheelabrator Tumblast, operated less than 300 hours. Spare parts. Size 27" x 36".

Molding Machines:
2—Tabor Jar ram, hand rollover, hand draw.
3—Johnson-Jennings, Wall type.
1—Arcade Squeeze, 6" cylinder.
2—Osborn Floor bumpers, 1—18" cylinder, table 42" x 60"
1—16" cylinder, table 30" x 36"
2—Universal Sandthrowers—220 V., 3 ph., 60 cy.

Dietert Sand testing equipment: laboratory normalizer, Permameter, Compression machine, Rammer, Moisture teller, scales & weights, A.F.A. Screens.
1—Ames hardness tester.
1—Lincoln Electric welder, 600 amp. 220 V, 3 ph., 60 cy.
3—Gyratory riddles "Speed Sifters" 1/3 h.p. 220 V, 3 ph. 60 cy.

Miscellaneous equipment includes quantity wood snap & metal slip flasks, jackets, bottom boards, wood flasks & bottom boards. Oil stoves, core ovens, ladles, wire cutter & bender. Stand grinders, vises, table saws, blowers, air grinders, chipping hammers, vibrators, pyrometers, wheelbarrows, scales, core racks, etc.

RIDGE CASTING CORP.
MINERAL RIDGE, OHIO

STEEL FLASKS—FOR SALE

We have recently purchased a complete inventory of flasks (mostly Sterling) in sizes from 10" x 26" to 50" x 60" and round flasks from 18" to 24" in diameter. These flasks are in very good condition and were in use until foundry operations of a large Massachusetts manufacturer were discontinued. To move this large stock of about 3500 flasks, we are offering all or any quantity thereof at very reasonable prices. For further details, address: Box 958, The FOUNDRY, Cleveland 13, Ohio.

FOR SALE

SPO No. 506 jolt rockover pattern draw machine. 24" by 25" table 10" draw. 1943 model. No. 275 Osborn jolt squeezers—$150 each.

BALCHER MACHINERY COMPANY
1884 S. COMPTON ROAD
CLEVELAND HEIGHTS 18, OHIO
TELEPHONE: FA 1-1186

FOR SALE

One full set of patterns of each for manhole and catch basin, standard for Cuyahoga and City of Cleveland, Ohio. Patterns new, four metal flasks.

BOX 110
THE FOUNDRY CLEVELAND 13, OHIO

FOR SALE

Complete set up for small foundry. All equipment in good shape. Take late model car as partial payment. Address: MR. NEWELL COWLES, 2976 ALPINE AVE., N. W., COMSTOCK PARK, MICHIGAN.

For Sale

FOR SALE

1 only #406 Osborn stationary jolt rollover pattern draw molding machine—flask capacity, max. length overall 78"; width outside 50"; flask space, minimum 13", maximum 24"; jolt cylinder diameter 16"; pattern draw 18"; jolt capacity at 80 lbs.; air pressure 500 lbs.; misc. spare parts; and auxiliary equip. for feeding sand to this unit. Our price is $5,000.00 f.o.b. Portland, Oregon. For further information write or call: ELECTRIC STEEL FOUNDRY CO., PORTLAND, OREGON.

NEW CLAMSHELL BUCKET

Blaw-Knox ⅜ c.y., size 306-1, single line, hook-on-type. Complete. Bowl counterweight. Recommended for rehandling foundry sand. Wt. 2800 lbs. New, guaranteed. Cost.....$1,470.00 A bargain at $1,000.00. Address: Box 951, The FOUNDRY, Cleveland 13, Ohio.

FOR SALE

1—36 x 42 Wheelabrator tumblast, new 1944. Owner installing larger machine.
2—Osborn #601 jolt rollover pattern draw molding or core making machines.
1—6 ft. Pangborn table rotoblast machine. Practically new. Used several months. Perfect condition.
2—276 J. Osborn molding machines.

BOX 123
THE FOUNDRY CLEVELAND 13, OHIO

FOR SALE

One Herman rollover moulding machine, late model, in excellent condition, size 40 x 58" 3740 pounds rollover capacity. Equipped with air clamps. Offered at bargain price. Address: Box 861, The FOUNDRY, Cleveland 13, Ohio.

FOR SALE

145—Sterling Steel Flasks—1 Pin on each side —12 x 18, 3 Cope & 3 Drag.
119—Truscon Steel Flasks—1 Pin on each side —12 x 18, 2 Cope & 3 Drag.

These Steel Flasks are practically new.
2—Tabor, Air Jolt, Rollover Machines 14 x 16 Table.
1—American Sand Cutter, Gasoline Driven.
1—Johnston & Jennings 24 x 30 Rollover.
1—Tabor 30 x 40 Rollover Machine.
1—27 x 36 Wheelabrator.
1—#9 Whiting Cupola complete with Motor, Blower, and Blast Regulator.
10—"G" Power Rollover Machines.
15—Jolt Squeezers of most any make.
1—Automatic lift truck with charger.
1—50" Moulder's Friend Sand Cutter with 15 HP Motor.
1—Grinding Wheel Stand 3 x 24" Wheels.
1—Marshke Swing Grinder with 5 HP Motor.
1—Stearns Magnetic Pulley, New. Serial #20442, 125 volts, RPM 40. Manufactured by Stearns Magnetic Mfg. Co., Milwaukee, Wisconsin.
1—Motor Generator Model #498 Induction motor generator set ¾ KW diverter pole generator, 125 volts @ 6 amp DC with 1½ HP 220/440/60/30 Across the line motor. New.
1—30 x 48 Tumbling Mill with motor, V-belt drive.
1—36 x 60 Tumbling Mill with motor, V-belt drive.
1—30 x 60 Whiting Mill with motor, V-belt drive.
1—SPO Jolt Squeeze Pin Lift Machine No. 614-P. Serial #122. Pattern No. 2138410.
1—"F" rod straightener with Jaeger attachment.

Osborn 558 and 559 Jolt Strippers.
Belting, New, 187 Ft. Ajax 20" 5 Ply 28 oz. conveyor belting with ⅛" top and 1/32" bottom cover.
J.D.P. International Jolt Strippers.
15—J-275 Osborn jolt squeezers
15—J-76 Osborn jolt squeezers

HAYNES FOUNDRY EQUIPMENT CO.
814 ADA ST. KALAMAZOO 52, MICH.

For Sale

FOR SALE

SHOT BLAST EQUIPMENT

1—PANGBORN G.J. ROTOBLAST BARREL #710363 with #5 P.L. loader. Type P.M. Condition good. Bargain.
1—PANGBORN TYPE G.K. #2 ROTOBLAST BARREL #14. Ser. 14GK2-4016 with loading device #14. Serial 14FN-411. Abrasive reclaimer #12. Excellent condition. Priced to sell.
1—PANGBORN #14 TYPE G.K. #5 ROCKER ROTOBLAST 40" x 49". Cap. 14 cu. ft. with loading device and #12. Style "C" Abrasive reclaimer. New—1948—Used 1 year.
1—36" x 42" AMERICAN WHEELABRATOR COMPANY TUMBLAST with loader and dustube collector all controls. Good condition.
1—8' AMERICAN WHEELABRATOR COMPANY TABLAST model BM-3 with dust unit.

MOLDING MACHINES

3—TABOR Jolt Squeeze Molding Machines
2—MOLINE Hand Squeeze Molding Machines
2—ARCADE Squeeze Molding Machines
2—OSBORNE JOLT Squeeze Molding Machines
1—CHAMPION Core Blower

GRINDERS

3—Portable Double End Grinders with 3 HP motor.
1—BLACK & DECKER Double End Pedestal Grinder with 3 HP motor.
1—Double End Heavy Duty Grinder 7½ HP motor.

CRANES

1—2 Ton Electric Bridge Crane 17'-0" span. 3 HP.
1—1 Ton BUDGET Electric Hoist. 220 volt.

MISCELLANEOUS

1—"NC-4" ROYER Sand Conditioner
1—CUPOLA BLOWER—Roots Connorsville Positive Pressure with 25 HP motor, 220 volt.
1—Harry W. Dieterts Company
Permeability Meter
Tensil Machine for Green & Dry Sand
Specimen Sand Ramer
2-12 Place Specimen Carrying Racks
1—Scale
1—Moisture Teller
12—Tons of #30 grit. New—Never Used.
26—Barrel Du Pont #6 Heat Treating Salts. 1050°—1850°.
3—Drums. Nu-Sal Rectifier Salts.

PARTIAL LISTING ONLY
ADVISE ANY OTHER EQUIPMENT YOU MAY NEED
FOUNDRY & HEAT TREATING EQUIPMENT NEW & USED & REBUILT
LAND-WHITEHEAD EQUIPMENT CORPORATION
P. O. BOX 756 READING, PA.

FOR SALE

MOLDING MACHINES

24—Osborne Jolt Squeezers Model 275J
1—Johnson & Jennings Roll-Over #610
1—Herman Roll-Over, 1500 Series
2—Osborne Jolt Pin Lift #559
6—International 20" x 8" Type G
3—International Core Machines Type R

27" x 36" Wheelabrator with Loader (Rebuilt)

2—P. & H. Cranes 50' span, 10 & 15 T Cap. A.C. Motors

RAY P. SCULLY
SCULLY MACHINERY & EQUIPMENT CO., NOT INC.
767 MILWAUKEE AVE. CHICAGO 22, ILL.
PHONE: CANAL 6-0314

MAGNETIC SEPARATOR

1—Model 5-14-46 tote all scrap saver powered by 2HP-3PH-60 cycle-220 volt geared head motor.

LADLES

2—Taper covered ladles with model C gearing—"V" type bail M289-#C48043

WOODRUFF & EDWARDS, INC.
119 N. STATE ST. ELGIN, ILLINOIS

FOR SALE

Brass furnace (2), Randall-twin demonstrating models, excellent condition—price greatly reduced. Address: THE FEDERAL FOUNDRY SUPPLY CO., 4600 E. 71st ST., CLEVELAND 5, OHIO.

Classified Advertising

For Sale

FOR SALE

MOLDING MACHINES
1—74W Osborn Plain Squeeze Portable
2—75W Osborn Plain Squeeze Portable
3—75J Osborn Jolt Squeeze Portable
3—Federal RAPID Jolt Squeeze Portable
2—SPO #611B Stationary Oscillating Jolt Squeeze Strippers
1—SPO #4½ JHS Air Jolt Hand Strip
BLOWERS FOR CUPOLAS AND FURNACES
1—40 H.P. Spencer-Turbine 5100 CFM 18-oz. pressure
1—Piqua Rotary Pressure Blower, rated 19 cu. ft per Rev.
Maxon-Premix Blowers for Gas, ¼ to 1 H.P.
METAL MELTING EQUIPMENT
1—Stationary crucible aluminum furnace, gas fired, 400# cap. complete with blower and motor
1—Hausfeld 2000# Aluminum Capacity Furnace, Barrel Type, open flame, oil fired
2—Monarch-Rockwell Rotating 500# Brass, Oil
New 32" to 41" Dia. shell Cupolas made to order
TUMBLING MILLS AND SAND BLAST
5—28 x 60" round exhaust mills
1—Pangborn No. 2 GH direct pressure type sandblast barrel, motor driven. Complete Unit
1—Pangborn Sand Blast Unit, including generating tank, shot cleaner, bucket elevator. Suitable for use with room
MISCELLANEOUS
1—Sprue cutter motor drive, 1½ x ¾ knives
1—Rotoplane speed sifter
7—Crane ladles, worm gear tilt, 1000 to 14,000# capacity
1—Continuous Heat Treat Furnace 57' long 1200° F. Max.
5—Koch electrically heated ovens for baking cores, 4½ ft. wide, 6 ft. high, 6 ft. deep, complete with recirculating fan and controls
1—Young Bros. Tower Core Oven, 5 ft. x 1 ft. shelves, gas fired, complete with Foxboro control
1—Young Bros. Batch Type Recirculating Hot Air, gas fired, Core Oven, 5 ft. x 6 ft. door opening, 9 ft deep
1—Lamson Endless Mold Conveyor, 100 ft. long x 16 ft. wide, with 19 x 26" pallets, 36" on centers
1—Bucket Sand Elevator, 50 ft. tall, complete
4—Heavy Duty Flexible Shaft Grinders 2 H.P.
Ingersoll-Rand air hoists, 2, 3, 5 ton cap.

CLIFTON MACHINERY CO.
1023 W. SIXTH ST. CINCINNATI 3, OHIO

FOR SALE

1—Hausfeld aluminum melting furnace, style 900-GT, gear tilting type, lined with firebrick and insulated. One F-550 cast iron pot for natural gas with a #8-A Hausfeld premixing type blower. Direct connected ½ HP 220 volt, 60 cycle, 3 phase motor. Brand new; never taken from crate. Cost $854.13. Will take $775.00. Address: MEMPHIS CASTING WORKS, INC., P.O. BOX 1622, MEMPHIS, TENNESSEE.

FOR SALE

1—4 x 8 Model "B" Simplicity Shake-Out; complete Left Hand V-Belt Drive, less motor. In excellent condition. In actual service only two months.

4—Tabor Overhead Squeeze Machines.

1—Davenport Jolt Machine, Type AJS #229.

1—Heavy Duty Direct Connected Electric Grinder, equipped with exhaust connections, safety type starter with push button control, 34½" between wheels, 1¼ x 2 x 20 wheel size.

BARNES MANUFACTURING CO.
MANSFIELD, OHIO

FOR SALE

2", 3", 4" drop pattern soil pipe machines, core machines, arbors, flasks, core knives, etc. We will manufacture any quantity desired.

BOX 962
THE FOUNDRY CLEVELAND 13, OHIO

For Sale

PRICED FOR QUICK SALE

2 NEW BARRETT TYPE CUPOLAS, 26" inside diameter, complete with blower. Capacity 2500 lbs. per hour each. Designed for platform loading and suitable for ferrous or nonferrous metals. These were erected but never used.

RANDALL GRAPHITE BEARINGS INC.
LIMA, OHIO

FOR SALE

Remaining equipment of Portland Sandblast Co. to be liquidated consisting of rotoblast machine, sandblasting machines, metallizing gun type 2E, dial Toledo scale, Westinghouse welder and many other items of interest to you. Write: BENNETT & ANDREWS, BOX 4177, PORTLAND 8, OREGON.

FOR SALE

4" shop pattern soil pipe machine and core blade. This machine is practically new, priced very reasonable. Address: Box 131, The FOUNDRY, Cleveland 13, Ohio.

FOR SALE

27 x 36" American Wheelabrator tumblast and loader. Excellent condition. Address: Box 115, The FOUNDRY, Cleveland 13, Ohio.

FOR SALE—HYDROBLAST

2—30 x 36 Whiting Hydroblast Casting cleaning machines complete with pump, ready for operation.

1—Coleman 5 drawer, gas fired core oven.

1—Lot snap flasks, bands and wood flasks.

KEYSTONE BRASS WORKS
ERIE, PENNSYLVANIA

SAND BLAST EQUIPMENT

Pangborn 28 GK2 Rotoblast Barrel, complete with Loader and $4,000.00 spare parts. A-1-Condition.—$5,000.00.
Pangborn 7GK2 Rotoblast Barrel with Loader, used very little.—$3,950.00.
Pangborn Direct Pressure Tank, Model AQ1, Excellent condition.—$575.00.
Pangborn 6 ft. table without motors—$800.00.
Sly Sand Blast Double Room, 8 x 8, 30% of list price.
Sand Blast Cabinets and Dust Collectors, all kinds and sizes, like new, 40% of list price.

DIAMOND SANDBLAST CO.
5654 W. JEFFERSON AVE.
DETROIT 9, MICHIGAN

FOR SALE

By Northeastern Ohio Foundry

1—Herman Pneumatic 10,000 pound Independent turnover and pattern drawing device, cylinder type equalizer with outboard bearings and 2 turnover plates, 66" x 72".

BOX 992
THE FOUNDRY CLEVELAND 13, OHIO

MOLDING MACHINES FOR SALE

2 Herman jar rollover 24" x 30", 1000 pound pattern draw machines. $600.00 each.

F.O.B. Our Plant

STANDARD PATTERN WORKS—
MACHINE DIVISION
6771 E. McNICHOLS ROAD
DETROIT 12, MICH.

For Sale

FOR SALE

CUPOLA BLOWER

1—Ingersoll-Rand Direct Connected Electric Motor Driven Centrifugal Blower S700 C.F.M. 1.25# per square inch pressure, 3500 R.P.M. complete with 75 H.P. 3 Phase 60 Cycle 220 Volt 40 Deg. C Rise Ball Bearing, Squirrel Cage, Induction Type Standard Open Motor. Manual Reduced Voltage Starter, Blast Gate Mechanism for Constant Air Weight Control assembled to 1-R Blast Gate and including two (2) Current Transformers and one (1) Air Weight Ammeter Calibrated in Lbs. of Air per minute and also amperes. First Class condition.

CORE BLOWER

1—Randall Core Blower complete with Clamping device. Practically New.

MOLDING MACHINE

1—#401-C (Johnston & Jennings) Portable Jolt Squeeze Molding Machine. Practically New.

SAND CUTTING MACHINE

1—Size #84 model AA American Sand Cutting Machine with cable reel and 100" 3-conductor rubber cable and plug; Motor driven by 10 H.P. G.E. Induction Motor—model #69A1—Type KT948-4—Form C—220 volts, 24.2 amps., 1800 r.p.m., 3 phase, 60 cycles; G.E. oil circuit breaker, 50 amps., 600 volts. Good Condition.

SAND MIXER

1—7 Cubic Ft. Capacity Freeman Multi Blade Mixer. Good Condition.

THE G. & C. FOUNDRY CO.
SANDUSKY, OHIO

FOR SALE

Complete pattern equipment for malleable pipe fittings, sizes ⅜" to 2", or will cooperate with a foundry to produce on percentage arrangement. Address: LAKESIDE FOUNDRY, WARSAW, INDIANA.

SPECIAL SALE ON JOLT SQUEEZERS

Following Machines have been completely rebuilt and in A-1 shape.
3—10" Haynes, Portable, Price $185.00 each.
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1—International, Portable, Strand Rod Type, 9" squeeze cylinder, 3" jolt cylinder—$165.00.
3—Adams, Portable, Strand Rod Type, 10" squeeze cylinder, 4" jolt cylinder—$165.00 each.
2—Milwaukee, Portable, Swing Head Type, 10" squeeze cylinder, 4" jolt cylinder—$175.00 each.
4—Milwaukee, Stationary, Swing Head Type, 10" squeeze cylinder, 4" jolt cylinder—$175.00 each.
1—Tabor, Portable, Cantilever Type—$165.00.
2—Milwaukee, 12" Stationary, Swing Head Type—$200.00 each.
1—Milwaukee, Stationary, 13" squeeze cylinder, 7" jolt cylinder—$210.00.

HAYNES FOUNDRY EQUIPMENT CO.
814 ADA ST. KALAMAZOO 52, MICH.

FOR SALE

TURBO BLOWERS (3 Phase, 60 Cycle)

cfm	Pressure	Make	Motor H.P.	Volts	Speed
3500	40 oz.	Spencer	60	440	1800
2200	40 oz.	Spencer	40	220/440	3600
1400	16 oz.	Spencer	220/440	3/60	3600
225	10	Spencer	1	220/440	3600

PRESSURE BLOWERS (3 Phase, 60 Cycle)

2500	7 oz.	Sturtevant	15	220/440	1800
2400	14 oz.	Mahr	15	220/440	3480
1300	16 oz.	Nth.Amer.	10	440	1800
1150	20 oz.	Nth.Amer.	10	220/440	3600
950	16 oz.	Nth.Amer.			
800	8 oz.	Sturtevant	7½	220/440	3600
800	24 oz.	American	10	220	3600
450	6 lbs.	A&B	30	220/440	3450
150	12 oz.	Nth.Amer.	1	220	3600

MOTOR REPAIR & MFG. CO.
1552 HAMILTON AVENUE
CLEVELAND, OHIO

Who's Who...

YOUR FOUNDRY PROSPECTS AND CUSTOMERS

- Names and Addresses of All Foundries
- Type and Number of Melting Units
- Capacity of Melting Units
- Type of Metal Melted
- Departments Operated

The 1949-1950 edition of Penton's Foundry List is your "Blue Book" of foundries—telling you who they are, where they are and what their capacities are. It gives complete information on the 5974 foundries in the United States and Canada—and is an indispensable sales aid to those who sell to the foundry industry.

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Malleable	154	Permanent Mold	575
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Exclusive	2292	Machine Shops	3289
Departments	1284	Pattern Shops	3934
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This well-known directory is just off the press and is now available for delivery. Order your copy today, so that you can check against your own records, search out new prospects, and plan your sales effort in this important market. The price complete is $50.00—less than 1c a foundry!

Compiled and Published by
THE PENTON PUBLISHING COMPANY
Penton Building, Cleveland 13, Ohio

THE PENTON PUBLISHING COMPANY, Book Department, F-8
Penton Building, Cleveland 13, Ohio

Please send a copy of the 1949-1950 Penton's Foundry List
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Company_____

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City_____ Zone____ State_____

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Refiners of Brass, Bronze and Aluminum

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REPRESENTATIVES IN PRINCIPAL CITIES

ADVERTISING INDEX

A

Accurate Match Plate Co. 161
Acheson Colloids Corp. 21
Acme Foundry Co. 226
Adams Co., The 42
Air Reduction 175
Air-Way Pump & Equipment Co. 225
Ajax Electric Co., Inc. 186
Ajax Electric Furnace Corp. 186
Ajax Electro Metallurgical Corp. 186
Ajax Electrothermic Corp. 186
Ajax Engineering Corp. 186
Ajax Metal Div. of H. Kramer & Co. 187
Allis-Chalmers 27, 39
Alloy Metal Abrasive Co. 230
American Bridge Co. 232
American British Chemical Supplies, Inc. 236
American Colloid Co. 61
American Lacquer Solvents Co. 236
American Optical Co. 219
American Smelting & Refining Co. 235
American Steel Abrasives Co., The 239
American Wheelabrator & Equipment Corp. 33, 34, 35, 36
Angell Nail & Chaplet Co., The 227
Apex Smelting Co. 145
Archer-Daniels-Midland Co., The Werner G., Smith Co. Div. 4, 5

B

Babcock & Wilcox Co., The 132
Baroid Sales Division, National Lead Co. 183
Bartlett, C. O., & Snow Co., The 121
Bay State Abrasive Products Co. 108
Beardsley & Piper Div., of Pettibone Mulliken Corp. 148, 149, 150, 151
Beryllium Corp., The 232
Black, Sivalls & Bryson, Inc. 167
Blaw-Knox Division of Blaw-Knox Co. 224
Bloomsbury Graphite Co. 228
Buffalo Forge Co. 41

C

Campbell-Hausfeld Co., The 174
Carl-Mayer Corp., The 22
Central Pattern Co. 209
Centrifugal Casting Machine Co. 237
Champion Foundry & Machine Co. 8, 9
Chicago Mfg. & Distributing Co. 229
Chicago Wheel & Mfg. Co. 154
Chisholm-Moore Hoist Corp. 200
Clark Equipment Co., Industrial Truck Div. 176
Clearfield Machine Co. 46
Cleco Division of the Reed Roller Bit Co. 223
Cleveland Chaplet & Mfg. Co. 233
Cleveland Flux Co., The 173
Cleveland Metal Abrasive Co., The 193
Cleveland Quarries Co., The 185
Cleveland Tramrail Div., The Cleveland Crane & Engineering Co. 54
Climax Molybdenum Co. 222
Columbus-McKinnon Chain Corp. 200
Corn Products Refining Co. 157
Crobaugh, Frank L., Co., The 208
Crucible Manufacturers Assoc. 201

D

Dayton Pneumatic Tool Co. 231
DeBardeleben Coal Corporation 236
Delta Oil Products Co. 12
Demmler, Wm., & Bros. 67, 234
Desmond-Stephan Mfg. Co., The 237
Despatch Oven Co. 62
Detroit Electric Furnace Division Kuhlman Electric Co. 199
Detroit Testing Machine Co. 210
Dietert, Harry W., Co. 216
Dings Magnetic Separator Co. 196
Dougherty Lumber 239
Drying Systems, Inc. 213

E

Eastern Clay Products, Inc. 177
Eastman Kodak Co. 159
Eaton Chemical & Dyestuff Co. 225
Eaton Metal Abrasive Corp. 220
Eldorado Mining & Refining, Ltd. 225
Electric Furnace Co., The 236
Electro Metallurgical Div., Union Carbide & Carbon Corp. 55
Empire Varnish Co., The (Waterlox Div.) 230
Erie Steel Construction Co. 217

F

Fanner Mfg. Co. 49
Federal Foundry Supply Co., The 2, 52, 53
Federated Metals Div., American Smelting & Refining Co. 58
Flash, M., Products Co. 237
Foundry Equipment Co., The 14
Fox Grinders, Inc. 190
Fremont Flask Co., The 10
Fuller Co. 44

G

Gardner-Denver Co. 18
General Electric X-Ray Corp. 20
Giffels & Vallet, Inc. 221
Globe Steel Abrasive Co., The 59
Goggle Parts Co., The 224
Gordon, Claud S. Co. 206
Great Lakes Carbon Corp. 32
Great Western Mfg. Co. 207
Green, A. P., Fire Brick Co. 47

H

Hauck Mfg. Co. 224
Hewitt-Robins, Inc. 63
Hickman-Williams & Co. 189
Hines Flask Co., The 30, 31
Hough, Frank G., Co., The 19

I

Imperial Belting Co. 211
Industrial Equipment Co. 213
International Graphite & Electrode Corp. 48
International Molding Machine Co. 137
International Nickel Co., Inc., The 1

J

Jackson Iron & Steel Co., The 231
Jeffrey Mfg. Co., The 23
Johns-Manville 188

K

Kirk & Blum Mfg. Co., The 66
Kramer, H., & Co., Ajax Metal Division 187
Krause, Chas. A., Milling Co. 103
Kux Machine Co. 60

Continued on page 260

ADVERTISING INDEX

L

Lanly Co., The 205
Lavin, R. & Sons, Inc. 258
Leitz, E., Inc. 235
Lindberg Laboratory Division 26
Linde Air Products Co., The, Unit of Union Carbide & Carbon Corp. 64
Link-Belt Co. Back Cover

Mc

McDonald, B. F., Co. 222
McKay Co., The 218

M

Master Pneumatic Tool Co., Inc., The 228
Mathews Conveyer Co. 123
Mathieson Chemical Corp. Inside Front Cover
Metal Blast, Inc. 153
Miller Motor Co. 125
Milwaukee Foundry Equipment Div., of SPO, Inc. 65
Milwaukee Leather Belting Co. 235
Modern Equipment Co. 262
Moline Iron Works 230
Multiplex Machinery Corp. 226
Murphy, Jas. A., & Co. 227

N

National Carbon Div., Union Carbide & Carbon Corp. 127
National Engineering Co. 141
National Lead Co., Titanium Alloy Mfg. Division 261
Neff & Fry Co., The 227
Newaygo Engineering Co. 50
Niagara Falls Smelting & Refining Division Continental Copper & Steel Industries, Inc. 204
Norton Co. 51, 56, 57, 114

O

Ohio Electric Mfg. Co., The 239
Oliver Machinery Co. 229
Osborn Mfg. Co., The 116, 117

P

Palmer-Shile Co. 232
Pangborn Corp. 6, 7, 143, 191
Penn Iron Works 228
Pittsburgh Crushed Steel Co. 178
Pittsburgh Lectromelt Furnace Corp. 181
Pittsburgh Metals Purifying Co. 155
Plaster Process Castings Co. 233
Pressed Steel Co., The 13
Prime-Mover Co., The 182
Producers Core Sand Corp. 236
Puro-Seal Co., The 236
Putnam, A. H., Co. 239

R

Radium Chemical Co., Inc. 233
Redford Iron & Equipment Co. 179
Republic Coal & Coke Co. 226
Republic Steel Corp. 15
Rice Pump & Machine Co. 236
Roots-Connersville Blower Corp. 203
Roura Iron Works, Inc. 231
Royer Foundry & Machine Co. 101
Royersford Foundry & Machine Co. 237

S

Safety First Shoe Co. 212
Schneible, Claude B., Co. 45
Schramm, Inc. 192
Scientific Cast Products Corp., The 214
Semet-Solvay Div., Allied Chemical & Dye Corp. 36
Shanafelt Mfg. Co., The 131
Silent Hoist & Crane Co. 209
Simplicity Engineering Co. 163
Smille, C. M., & Co. 229
Smith Oil & Refining Co. 43
Smith, Werner G., Inc. 107
Smooth-On Mfg. Co. 234
Sonken-Galamba Corp. 210
SPO, Inc. 65, 180
Standard Conveyor Co. 202
Standard Horse Nail Corp. 215
Standard Pattern Works, Machine Division 206
Standard Silica Corporation 236
Steel Shot & Grit Co. 178
Sterling Wheelbarrow Co. 68, 217
Stevens, Frederic B., Inc. Inside Back Cover
Stroman Furnace & Engineering Co. 11
Syntron Co. 211

T

Tabor Mfg. Co., The 165
Tamms Industries, Inc. 208
Taylor, Chas., Sons Co., The 24
Timken Roller Bearing Co., The 25
Titanium Alloy Mfg. Division, National Lead Co. 261
Tousey Varnish Co. 28
Truscon Steel Co. 37

U

Union Carbide & Carbon Corp. Electro Metallurgical Div. 55
Union Carbide & Carbon Corp., The Linde Air Products Co., Unit 64
Union Carbide & Carbon Corp., National Carbon Div. 127
United States Graphite Co., The, Division of The Wickes Corp. 169
United States Rubber Co. 29
United States Steel Corp. 232
United States Steel Corp., Subsidiaries 232
United States Steel Export Co. 232
Universal Engineering Co. 128

V

Vanadium Corporation of America 113
Vonnegut Moulder Corp. 234

W

Wadsworth Equipment Co. 237
Wedron Silica Co. 215
Wellman Engineering Co., The 237
Western Metals Co. 184
Westover Engineers 237
Wheland Co., The 40
Whiting Corporation Front Cover, 16, 17
Wickland, A. A., & Co. 239
Will, Arthur E. 212
Woodward Iron Co. 105
Classified advertisers, 253, 254, 255, 256

Table of Contents, page 3

TAM* Zircon grog type ramming mix

Linings always last over 200 heats at Induction Steel Casting Company

Tapping Heat from 1000 lb. Allis-Chalmers Induction furnace at Induction Steel Casting Co.

*TAM zircon lining after drying out...ready for first melt.

Furnace ready for relining after 261 heats.

The experience of Induction Steel Casting Company of East Detroit, Michigan is typical of the extended lining service life that can be expected from TAM* zircon grog type ramming mix. Their lining life is always over 200 heats.

The 1000 lb. induction furnace shown here was used to melt 261 heats before relining was required. During this period, S.A.E. 1025 and 1030, 12% Cr. —1½%C., 4630, 6145 and die steel containing .50C. and 1.0% Cr. were the alloys poured.

This long service and resultant increased furnace efficiency is due directly to the excellent resistance of TAM* lining material to high temperatures and erosive action. It explains why more metal is melted at less cost per ton when TAM* ramming mixes are used.

Detailed facts on TAM* ramming mixes may be obtained from our field engineers or by writing our New York office. It will pay you to have these facts.

TAM PRODUCTS
Registered U. S. Pat. Off.

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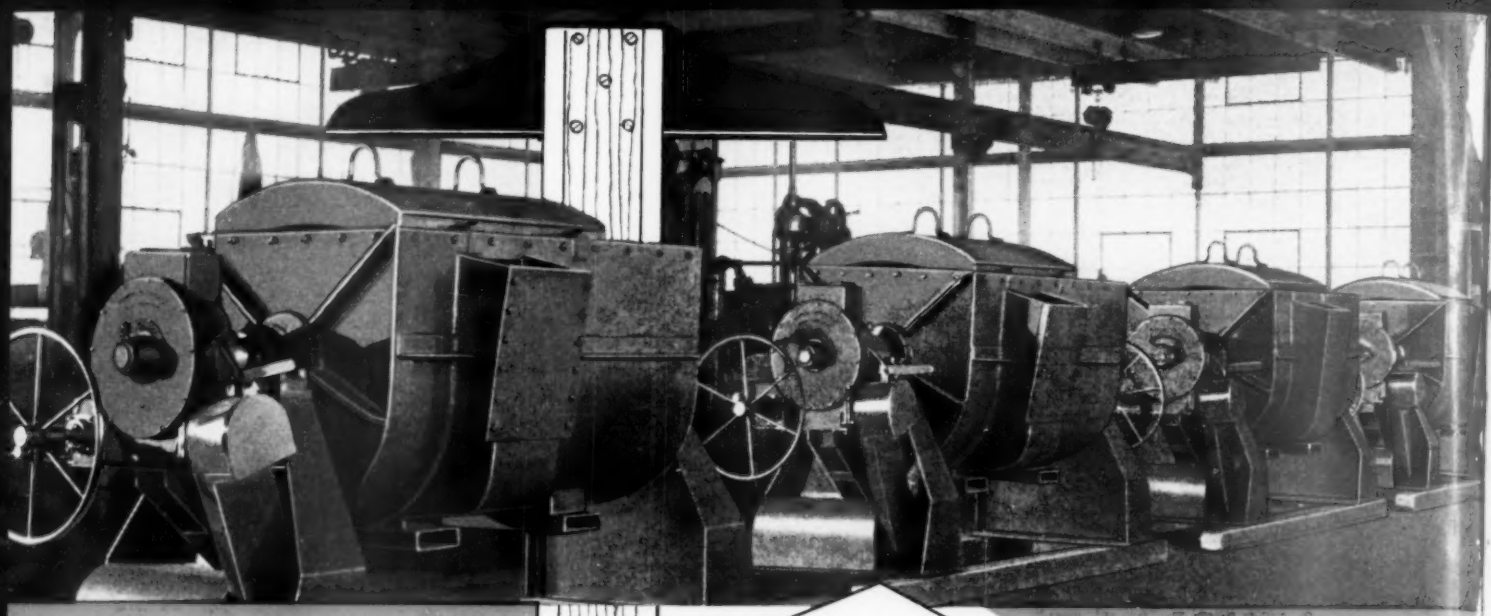
TITANIUM ALLOY MFG.. DIVISION
NATIONAL LEAD COMPANY

Executive and Sales Office: 111 BROADWAY, NEW YORK CITY · General Offices, Works, and Research Laboratories: NIAGARA FALLS, N.Y.



A *MODERN* 50,000 lb. capacity, 86" top diameter, geared, tapered, bottom-pour ladle.

Engineering Ability and MANUFACTURING FACILITIES for the PRODUCTION of LARGE or SMALL FOUNDRY EQUIPMENT

A shipment of *MODERN* 6000 lb. capacity U-shaped motorized mixing ladles ready for shipment to a well-known automotive plant.

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Four *MODERN* No. 9 Cupola Body Sections, designed for hot-blast; loaded on railway car for shipment to a large automotive foundry.

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ELIMINATE METAL PENETRATION IN YOUR CASTINGS *with* STEVENS No. 125 CORE WASH

A High Fusion Point Core Coating for Iron and Brass Castings

● Stevens No. 125 Core Wash is the perfect core coating for your iron and brass foundry operations. Its high fusion point and strong bond allow the pouring of iron in heavy casting sections at extremely high temperatures.

In brass casting, No. 125's tight sealing qualities eliminate metal penetration into the sand by bronzes containing high lead, tin, zinc and phosphorus—all alloys which tend to "search" or "seep" into the core.

Stevens No. 125 virtually guarantees smooth castings and clean peel. Since it is white in color, it helps light up the mold cavity, permitting the more accurate setting of cores, and reveals clearly any misses and thin spots in the coating.

No. 125 Core Coating can be applied by brush, spray or dip. It stays in suspension, brushes out smoothly and sprays freely. It will not ferment, foam or bubble.

Stevens offers foundry service for every type of operation. If you have a casting problem—send us the complete data on your work and installation, and the Stevens technical staff will recommend a solution that will best serve your needs.

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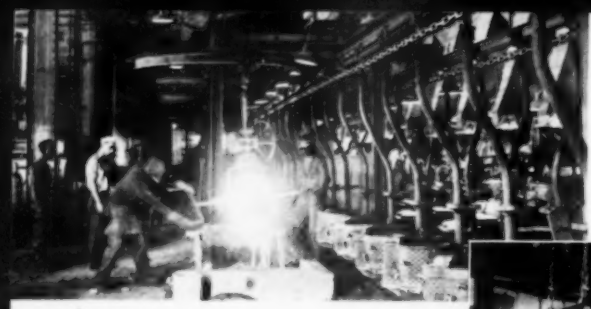
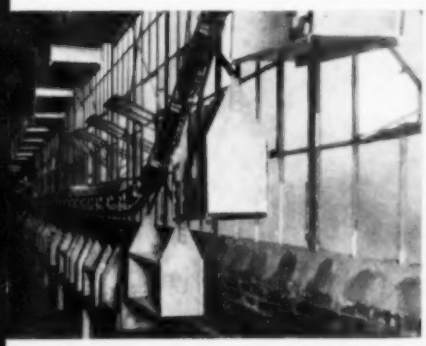
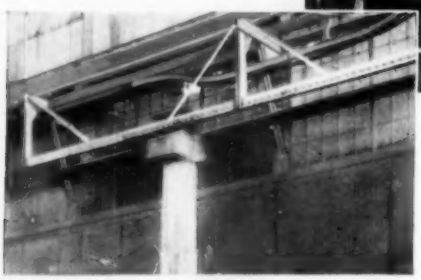


Link-Belt trolley conveyor for carrying the molds requires minimum space.

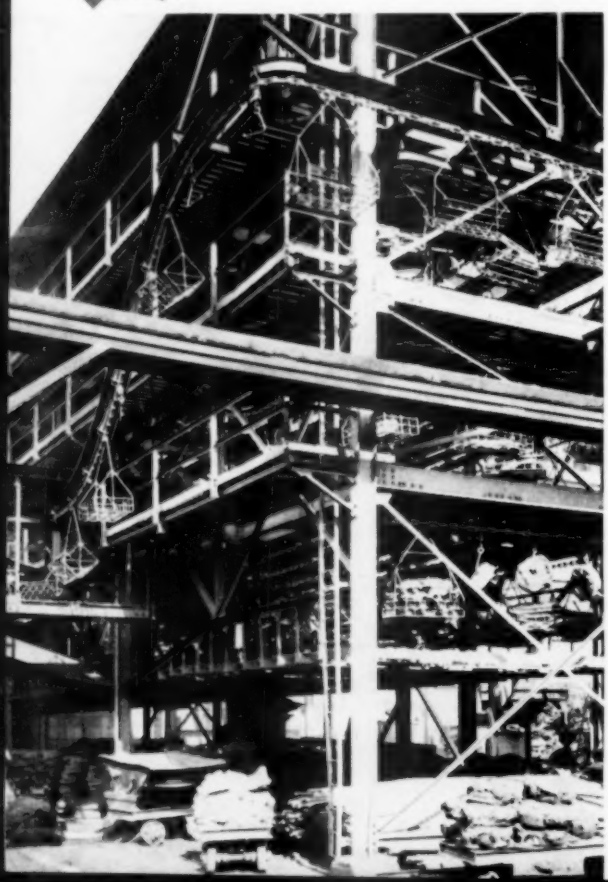


Core transport and storage conveyor.



Overhead trolley conveyor handling and automatically discharging sprue in charge-make-up area.

Cooling tower with overhead conveyor handling individual castings.



Casting from shakeout stations are handled in perforated buckets suspended from trolley conveyors.

LINK-BELT Trolley Conveyor Systems *Offer Many Advantages*

A Link-Belt trolley conveyor system is easily installed around existing equipment because the conveyor is supported from overhead—uses no floor space, in fact releases floor space for added production facilities. Any irregular path and the most suitable speed for the production requirements are employed. Little power is required to operate the conveyor and it is practically maintenance-free. In the pouring operation, larger ladles are handled—speeding the output with a saving in heat losses. Foundry production can be carried on at an even flow. And, with heavy lifting and carrying eliminated, working conditions are safer and better. All these advantages add up to appreciably lower costs.

Let Link-Belt experienced foundry engineers help you in applying a trolley conveyor system; also sand preparation and sand, mold, core and castings handling equipment. Ask our nearest office.

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